Iron and Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

OCTOBER, 1951

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TECHNOLOGY DEPT.

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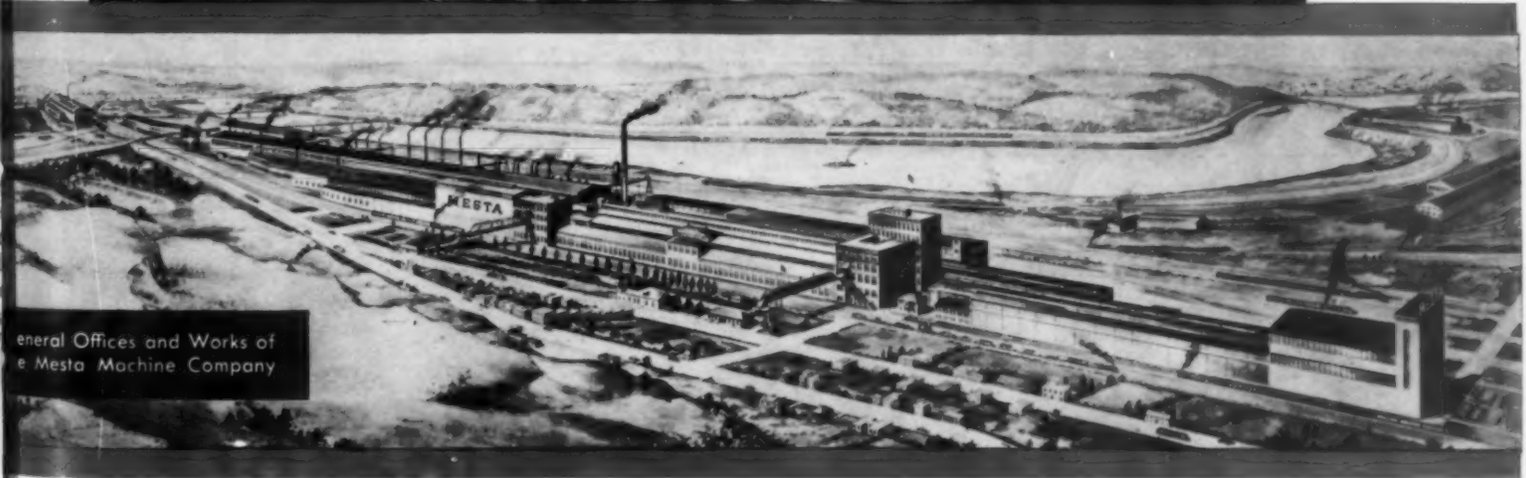


eneral Offices and Works of
e Mesta Machine Company

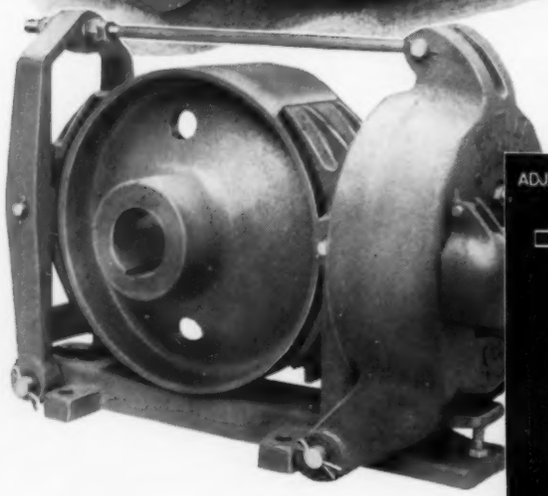
Mesta equipment is produced from raw materials to finished product in this unit plant, the largest of its kind in the world.

Designers and Builders of Complete Steel Plants

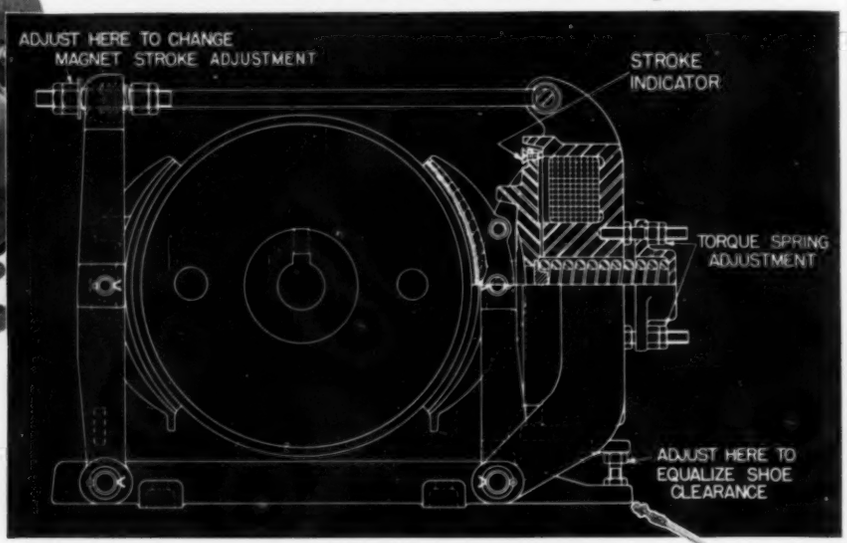
MESTA MACHINE COMPANY

PITTSBURGH, PENNSYLVANIA

Still the Leader!



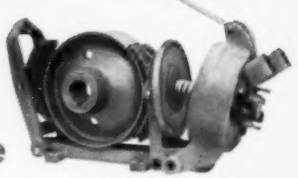
The design of the Type M Brake is so fundamentally correct its performance has never been equalled


ADJUST HERE TO CHANGE MAGNET STROKE ADJUSTMENT
STROKE INDICATOR
TORQUE SPRING ADJUSTMENT
ADJUST HERE TO EQUALIZE SHOE CLEARANCE

Common sense says there *must* be a best way of doing *any* job. It follows as a consequence any method not equal to the best *cannot* produce equal results. There never has been a mill brake as simple in design or as direct in application of braking power as the Cutler-Hammer Type M Brake. And if the popularity of this brake through the years is a criterion, there never has been a brake to equal it in performance.

The action is a direct push of the shoes against the wheel. Since both the field member and armature move in braking and release, action is lightning fast. The simple design eliminates parts that usually cause trouble and need adjustment and repair. Tough lining matched with durable alloy steel wheel reduces lining wear. Take-up adjustments are needed only at long intervals. Many heavy duty installations prove the Type M Brake to have no equal in performance. Write for Publication BR-2 giving full facts on this brake. CUTLER-HAMMER, Inc., 1257 St. Paul Avenue, Milwaukee 1, Wis. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto, Ontario.

14 FACTS about Type M Brake



- √ Fundamental design proved by years of service in heavy duty applications
- √ The simplest of all brakes
- √ Has the fewest parts
- √ The brake with the fastest action
- √ The only brake with one-to-one magnet and total shoe stroke
- √ The brake with only 3 simple adjustments
- √ Longest service without take-up adjustments
- √ Tough long-life lining matched with hard Hammerloy steel wheel
- √ Cover-all tubes shield full length of hinge pins against paint, dirt, etc.
- √ Renewable hardened hinge pin bushings
- √ Hard sheet aluminum magnet coil cover plate caulked in place with aluminum wire
- √ Torque spring compression CANNOT be released manually
- √ Torque spring fully protected
- √ Brass friction plugs keep shoes always aligned

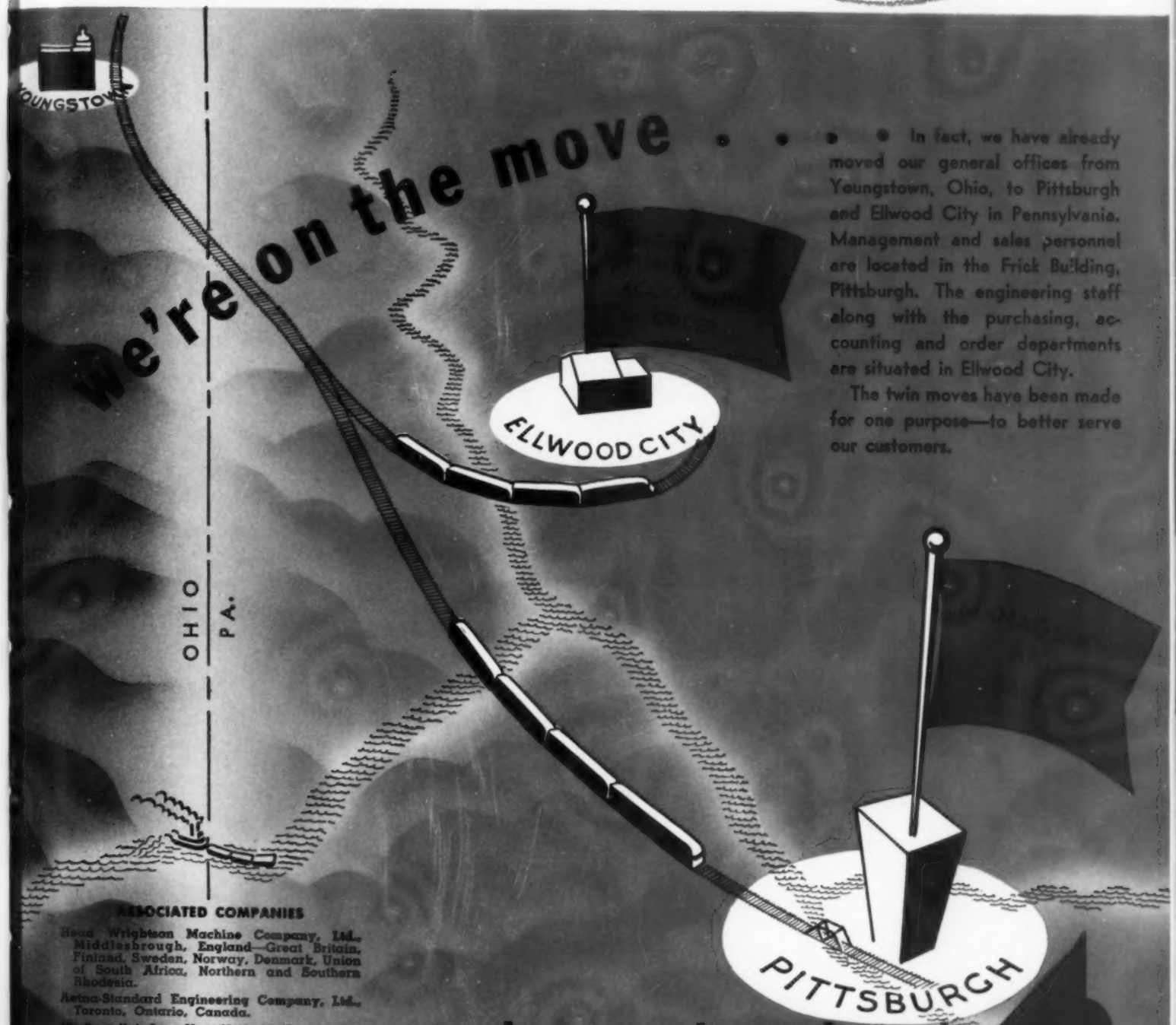
All of these features are also provided, when used on A.C. Service with rectifier

CUTLER-HAMMER
MOTOR CONTROL
C-H

It Set the Pattern Years Ago • It has Set the Pace Ever Since

IRON AND STEEL ENGINEER; published monthly by Association of Iron and Steel Engineers, 1010 Empire Bldg., entered as second class matter January 25, 1924 at Pittsburgh, Pennsylvania, under Act of Congress, March 3, 1879. $7.50 per year in United States and Canada, $10.00 foreign countries. Volume 28, No. 10

Fifty years
OF CREATIVE ENGINEERING



We're on the move . . .

. . . In fact, we have already moved our general offices from Youngstown, Ohio, to Pittsburgh and Ellwood City in Pennsylvania. Management and sales personnel are located in the Frick Building, Pittsburgh. The engineering staff along with the purchasing, accounting and order departments are situated in Ellwood City.

The twin moves have been made for one purpose—to better serve our customers.

ASSOCIATED COMPANIES

Head Wrightson Machine Company, Ltd., Middlesbrough, England—Great Britain, Finland, Sweden, Norway, Denmark, Union of South Africa, Northern and Southern Rhodesia.

Aetna-Standard Engineering Company, Ltd., Toronto, Ontario, Canada.

[illegible]-Castellvi, Inc., New York, N. Y.—Mexico, Central and South America.

Société de Constructions de Montbard, Paris, France—France, Belgium, Holland, Luxemburg, Switzerland.

[illegible] Aktiengesellschaft, Duisburg, Germany—Germany, Austria, Yugoslavia, Greece, Turkey, Egypt.

Compagnia Italiana Forme Acciaio, Milano, Italy—Italy.

Aetna-Japan Company, Ltd., Tokyo, Japan—Japan.

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aetna-standard

THE AETNA-STANDARD ENGINEERING COMPANY • PITTSBURGH, PA.

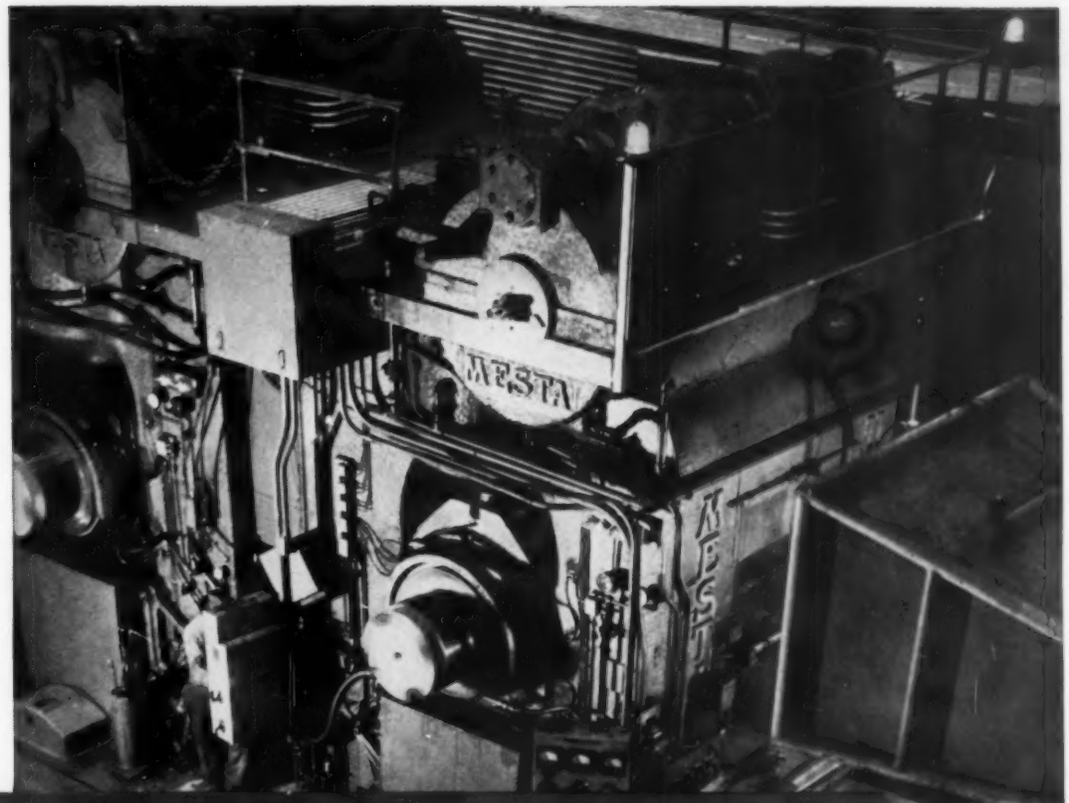
Plants in Warren, Ohio • Ellwood City, P[illegible]

You make a good move . . . when you specify *National Rolls*

Why? Because you can depend on them for consistent, uninterrupted performance on your stands. The durability and strength built into every National Roll means greater tonnage life on your stands and fewer shut-down for roll changes.

Whether your requirements call for iron or alloy iron rolls in rough, semi-finished or finished form, National can supply them to meet your exact requirements. Specify National Rolls and see.

THE NATIONAL ROLL & FOUNDRY CO.
Avonmore, Pennsylvania
SPECIALISTS IN IRON AND ALLOY IRON ROLLS AND CASTINGS



INCREASED PRODUCTION... REDUCED MAINTENANCE COSTS

. . . when oil film roll necks are lubricated with TEXACO REGAL OIL

For uninterrupted production, lubricate oil film backup roll necks with *Texaco Regal Oil*. This heavy-duty, turbine-grade oil forms a tough oil film . . . keeps circulating systems clean . . . assures a constant flow of cool, clean lubricant to the bearings. Operation is smoother, quieter . . . bearings last longer . . . maintenance costs drop.

There is a complete line of *Texaco Regal Oils,* all of which resist oxidation, emulsification and sludging, and carry heavy loads under all operating conditions. Join cost-conscious operators everywhere, switch to *Texaco Regal Oil*—your best bet for higher efficiency . . . lower maintenance costs.

In enclosed reduction gear drives, use *Texaco Meropa Lubricants*. They resist oxidation, will not foam . . . assure longer gear life and lower maintenance costs.

A Texaco Lubrication Engineer will gladly help you increase efficiency and cut costs throughout your mill. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

VISIT THE TEXACO EXHIBIT AT THE METALS SHOW · BOOTH C-103 · DETROIT, OCTOBER 15-19

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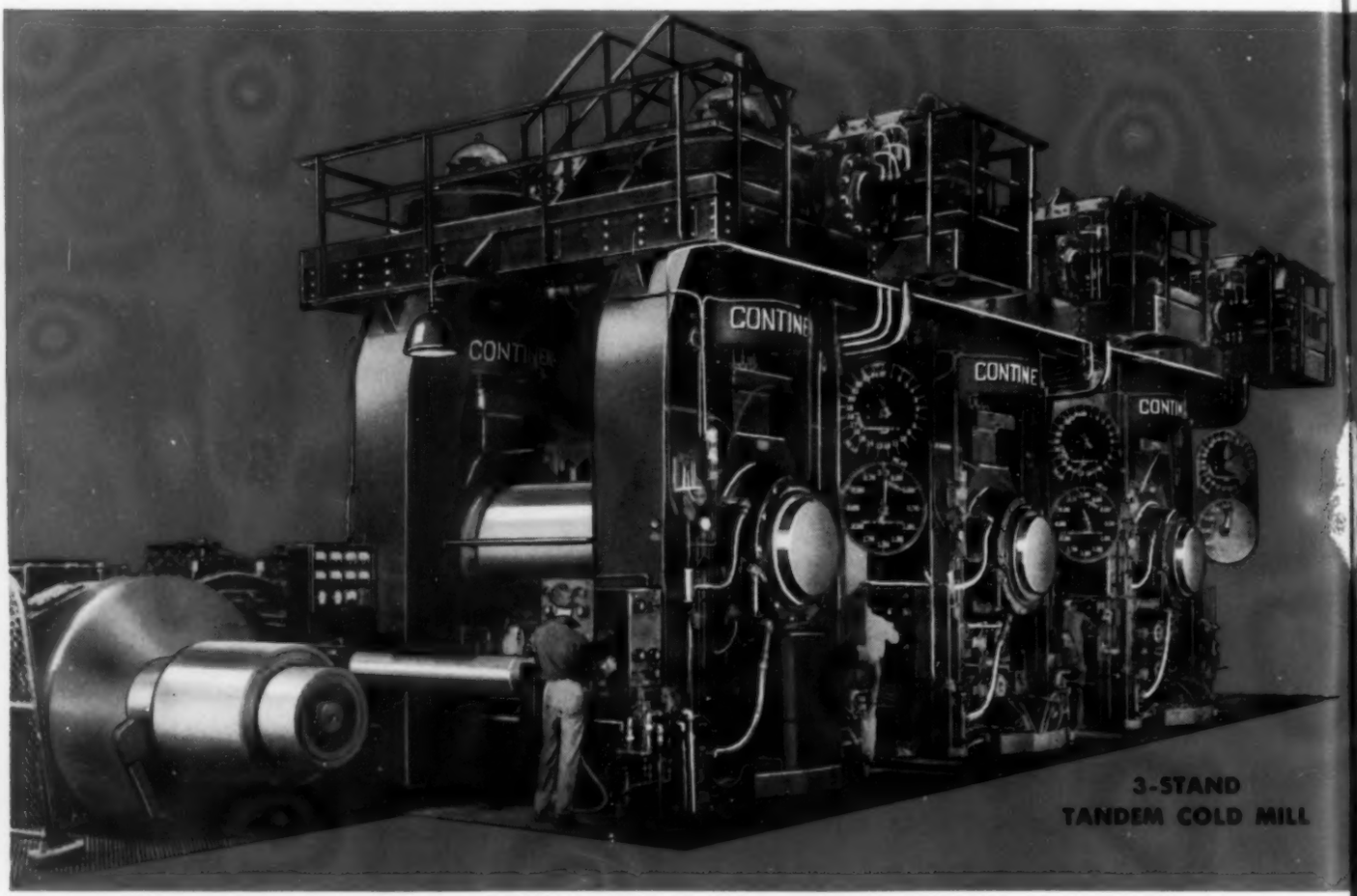
TEXACO Regal Oils

(HEAVY CIRCULATING OILS)

TUNE IN . . . TEXACO STAR THEATER starring MILTON BERLE on television every Tuesday night. See newspaper for time and station.

Continental **ROLLING**

of all types, including auxiliary



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TANDEM COLD MILL

PRODUCERS OF: Complete Rolling Mill Installations including:

Blooming Mills	Plate Mills	Non-Ferrous Mills	Tables
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Billet Mills	Hot Strip Mills	Charging Box Cars	
Merchant Mills	Cold Strip Mills	De-Pilers	

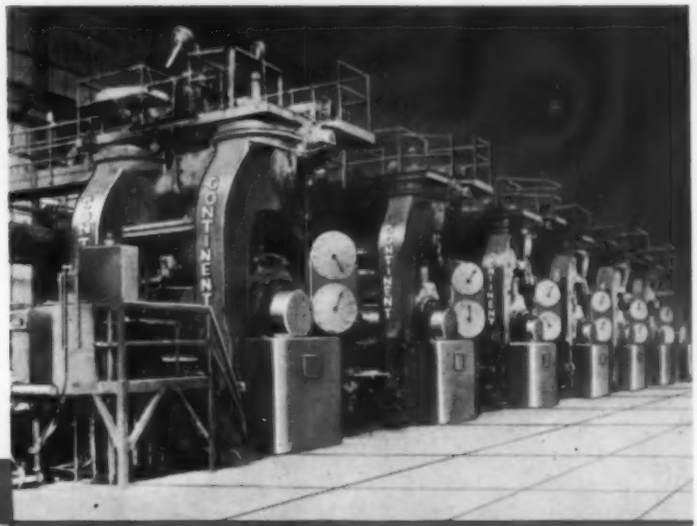
IRON, ALLOY IRON and STEEL ROLLS for ferrous and non-ferrous rolling mills; pulp and paper industry; textile industry; and milling, cereal and vegetable oil industries.

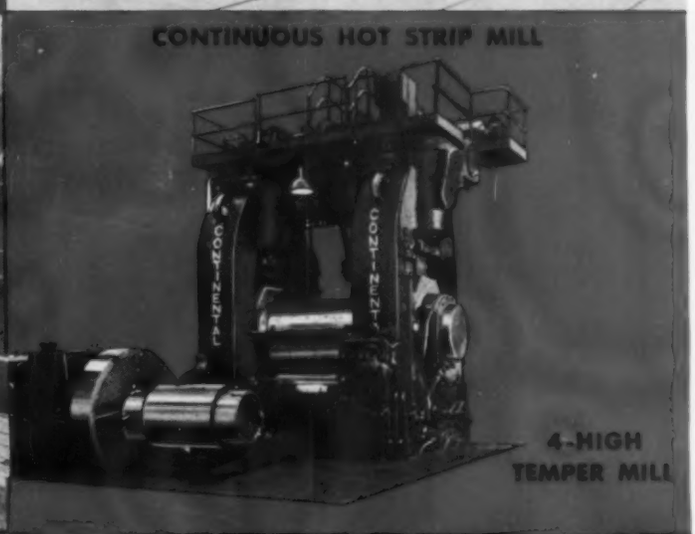
* * *

CARBON and ALLOY STEEL CASTINGS from 20 to 250,000 pounds. Complete heat treating and machining facilities.

MILLS

equipment





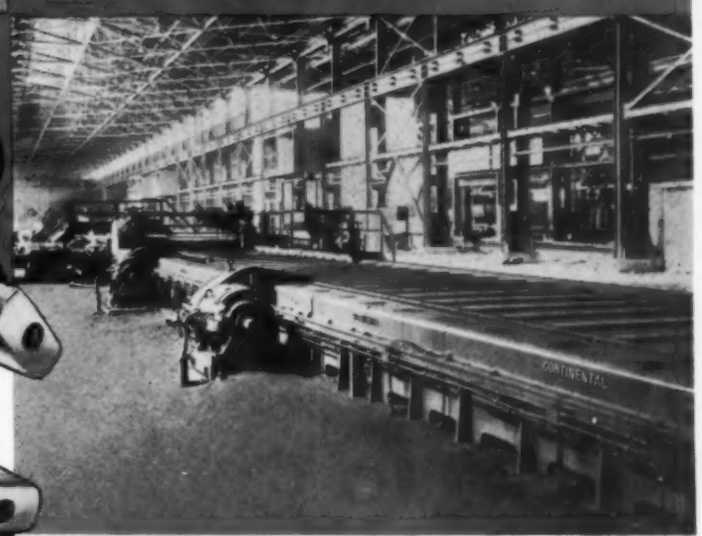


PLATE MILL LEVELER AND TABLES

Continental

FOUNDRY & MACHINE CO.

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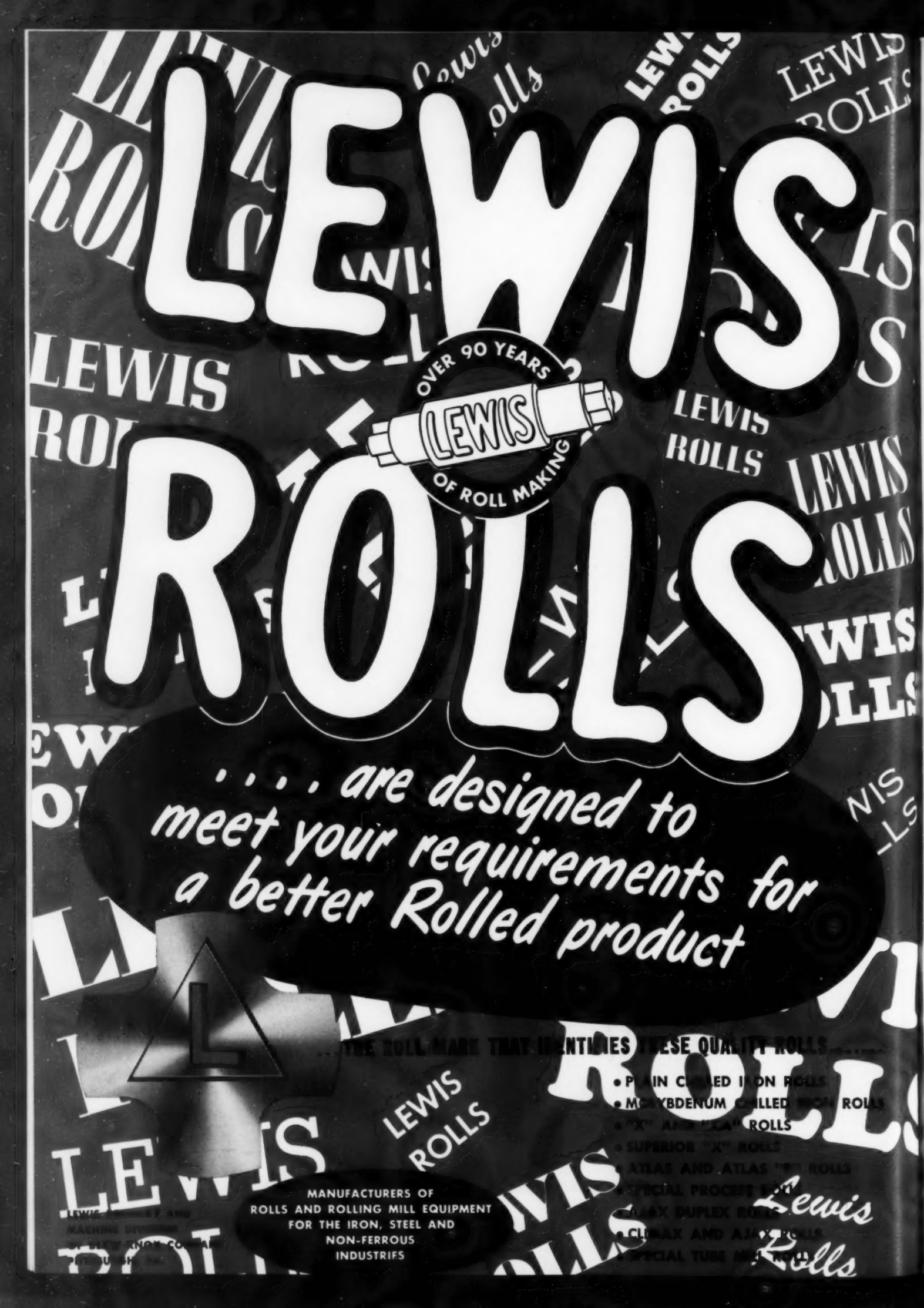
ROLLS—
STEEL CASTINGS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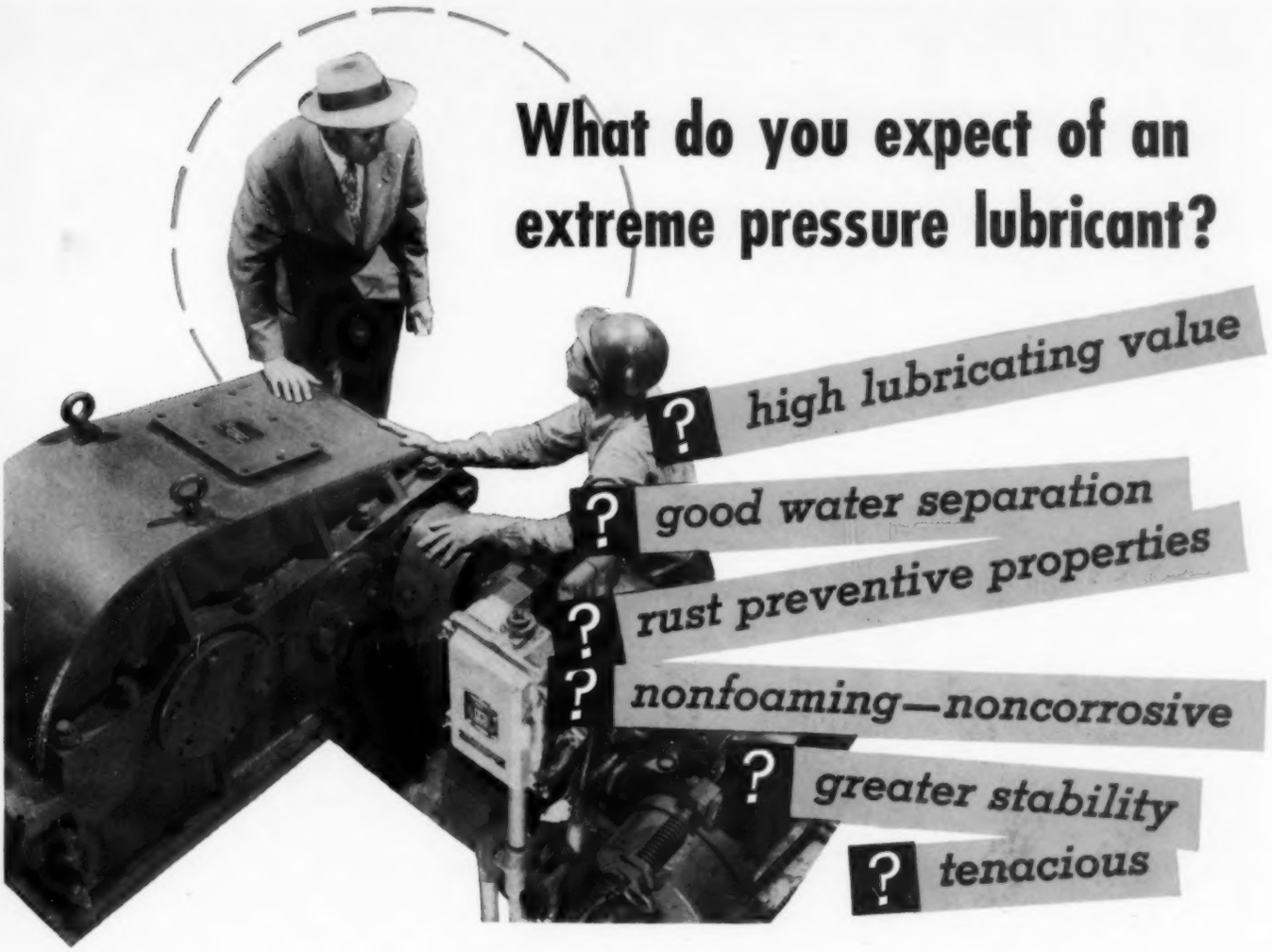
What do you expect of an extreme pressure lubricant?
? high lubricating value
? good water separation
? rust preventive properties
? nonfoaming—noncorrosive
? greater stability
? tenacious

You'll get them all with GULF E.P. LUBRICANTS

All the desirable properties of extreme pressure lubricants are combined in Gulf E. P. Lubricants to insure longer gear and bearing life, and lower maintenance costs for steel mill gear drives.

Gulf E. P. Lubricants are specially compounded to withstand the shock loads and high pressures encountered in the toughest service. And they are outstanding in their ability to separate from water. When the proper grade is used and good maintenance practice is employed, lubrication difficulties caused by water can be minimized.

Other advantages: nonfoaming—saves loss of lubricant and mopping up; tenacious—minimizes channeling and throwoff; extremely stable for this type of lubricant; help prevent rust; and they are just as suitable for the lubrication of all types of bearings.

Gulf E. P. Lubricants are available in the proper viscosity for every gear requirement, ranging from 55 to 1050 S.U.V. at 210°F. For specific recommendations for your equipment, call in a Gulf Lubrication Engineer today. Write, wire, or phone your nearest Gulf office, or send the coupon below.

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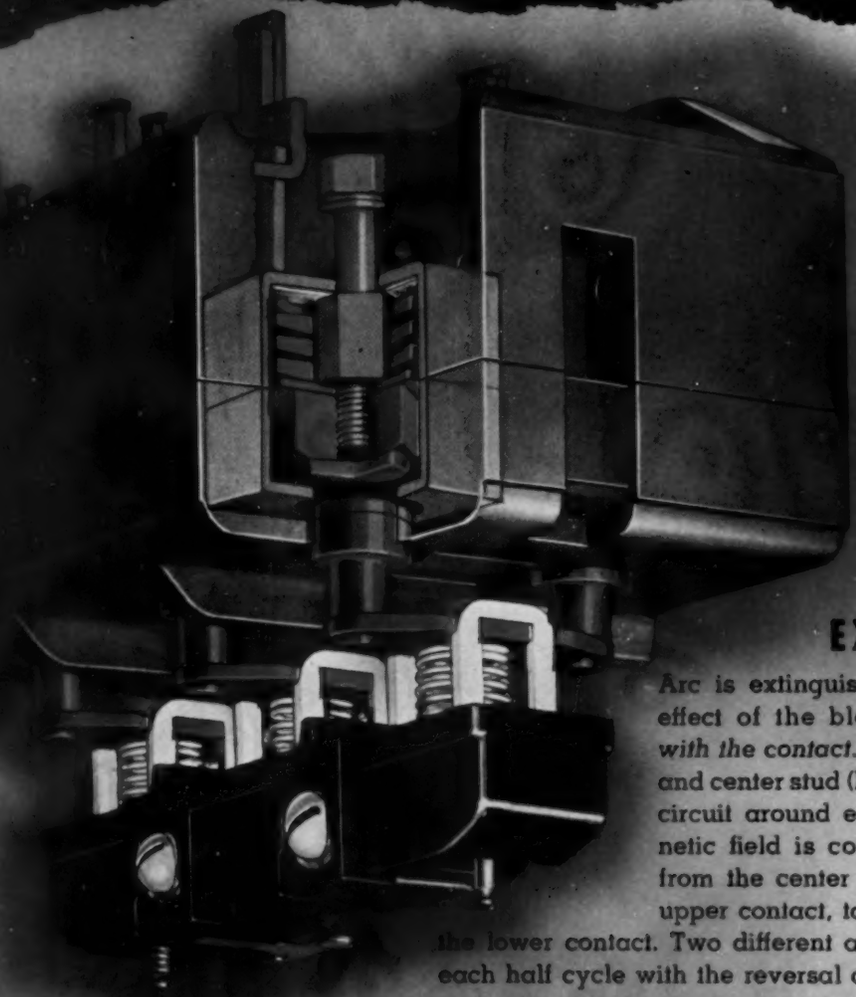
Gulf Oil Corporation · Gulf Refining Company I&SE
719 Gulf Building, Pittsburgh 30, Pa.

Please send me, without obligation, a copy of your pamphlet "Gulf E. P. Lubricants for Rolling Mill Gears and Pinions."

Name.....
Company.....
Title.....
Address.....

The All New CLARK TYPE "CY" AC MOTOR



Phantom view showing arc shield

Here's how the ARC is EXTINGUISHED

Arc is extinguished by applying the effect of the blow-out coil *concentric with the contact*. The steel arc chamber and center stud (blue) form the magnetic circuit around each contact. The magnetic field is concentrated in a cone from the center stud that supports the upper contact, to steel rim surrounding the lower contact. Two different actions occur, changing each half cycle with the reversal of the current.

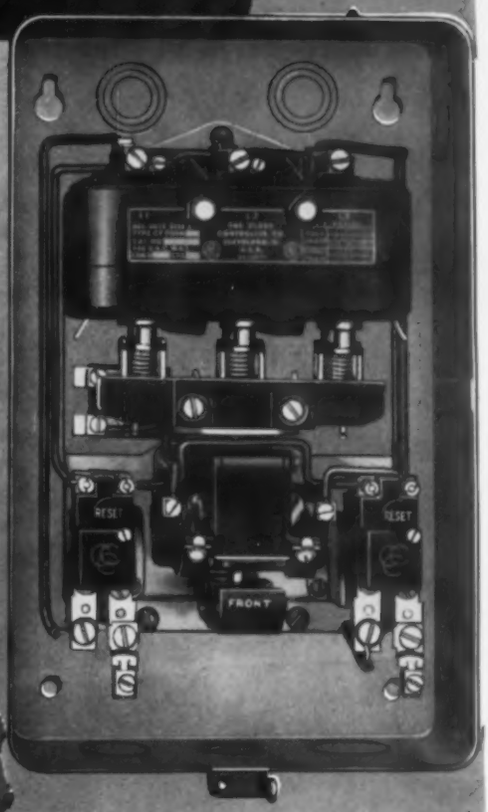
In one current direction the arc is forced to the outer edge of the upper contact, lengthened and rotated. In the other, the arc is rotated and forced to the middle of the upper contact. In each case, the magnetic field tends to quench the arc, either by lengthening it or confining it.

Constant forced rotation of the arc, moving continually from a hot to a cold spot, minimizes burning and pitting of contacts.

Let a CLARK application engineer show you what this BLUE RIBBON PRODUCT means to you in increased production and lower maintenance.

CLARK ENGINEERED ELECTRICAL CONTROL

STARTER features an entirely new principle in ARC INTERRUPTION



Another CLARK First! In the Type "CY," CLARK offers, for the first time, a line of AC Motor starters that gives you the extra protection of "Mill-Type" heavy-duty construction and design. These new starters feature the combined use of strong multi-turn magnetic blow-outs and twin-break contacts* to achieve a new high in arc-interrupting efficiency.

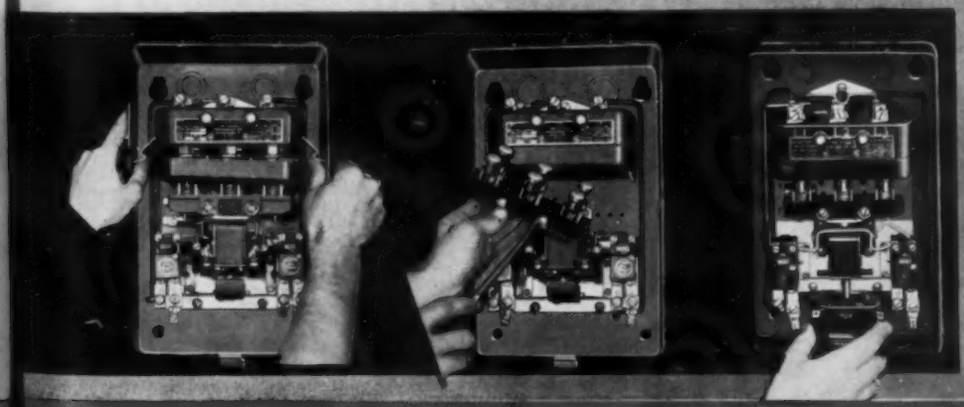
Other important advantages include:

- One piece upper arc shield, closed at the top, to prevent accumulation of hot gases between wiring terminals, minimizing phase-to-phase failures.
- Magnetic arc interrupters in steel arc chambers.
- Silver alloy double break contacts.
- Melting-alloy type overload relays.
- Vertical-lift clapper type magnet with straight line guided movement, using no springs.

*Magnetic blow-out coils are used on all Size 2 and 3 "CY" Starters. Sizes 0 and 1 use the same general Mill-Type construction as larger sizes.

The Maintenance Man's Dream

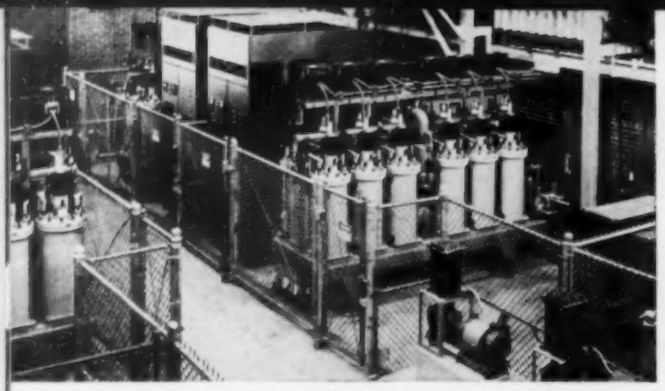
The new arc interrupting principle and twin-break silver-alloy contacts, assure longer contact life. No filing, dressing or cleaning of contacts is required. Inspection and maintenance are further simplified by design features.



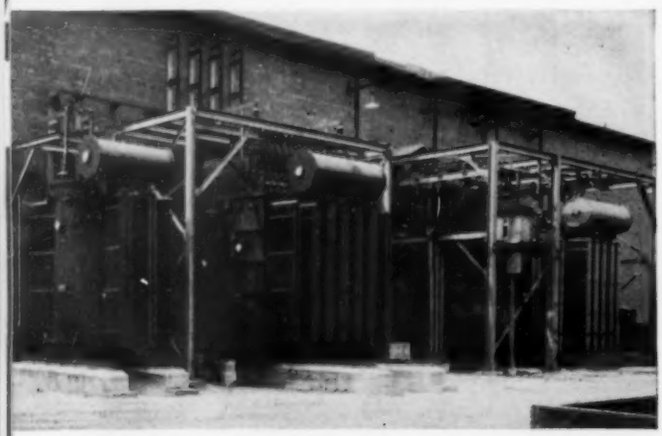
- No tools needed to inspect contacts.
- Moving contacts easy to change.
- Stationary contacts quickly changed.
- Remove only two screws and one pin to change coils.
- All parts removable from the front.

THE CLARK CONTROLLER CO.

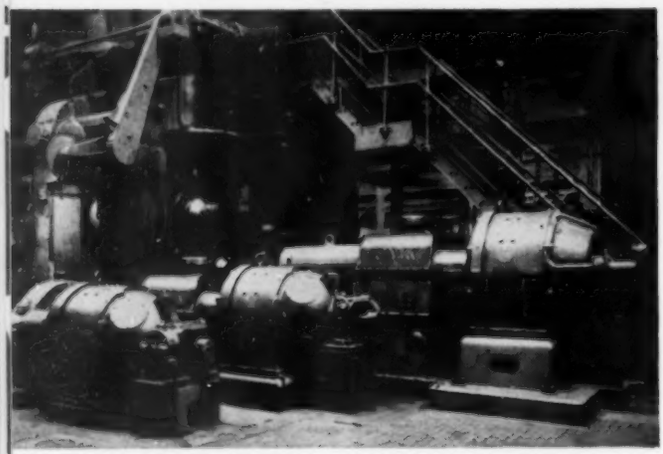
1146 EAST 152ND STREET · CLEVELAND 10, OHIO



Interior view of building housing the Allis-Chalmers 16,000 kw mercury arc frequency changer. By-product power—largely generated by Allis-Chalmers steam turbines and gas engines at nearby Gary Steel Works and South Works — is converted from 25 cycles at 23 kv to 1750 volt dc along right side of building. Inverter along left side changes dc to 60 cycles at 6.6 kv linking with the purchased power system.

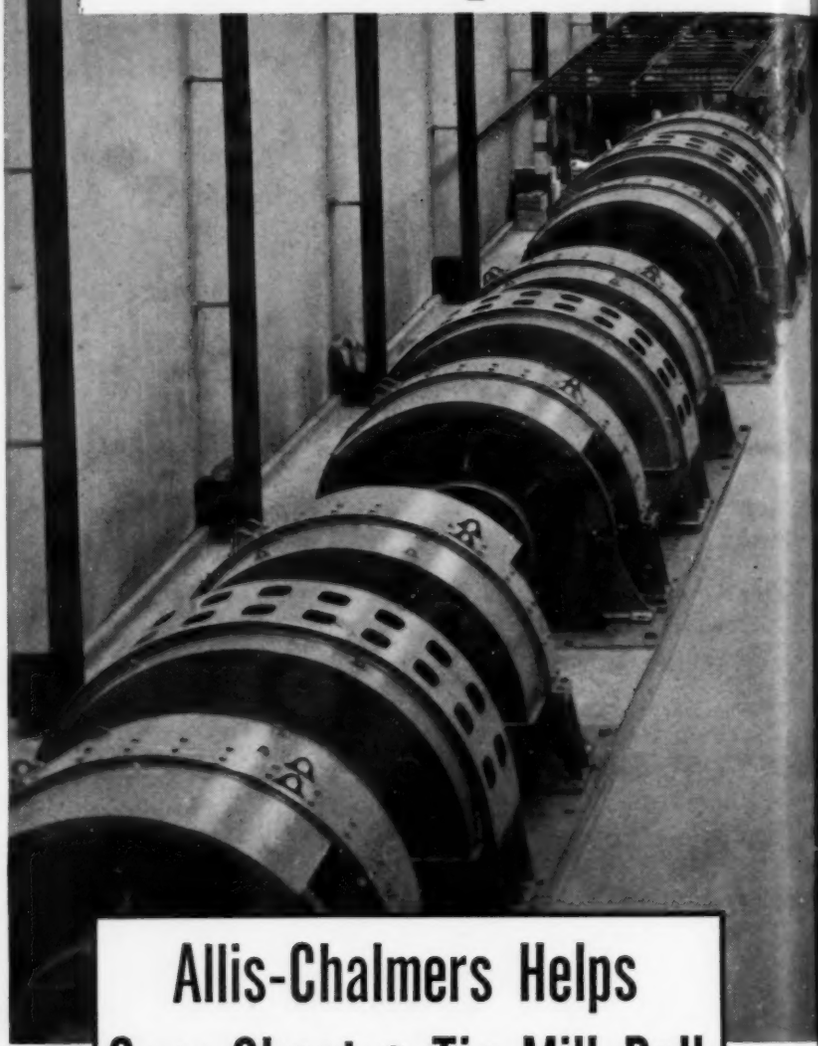


Allis-Chalmers rectifier transformers, reactors and oil circuit breakers serve the 16,000 kw mercury arc frequency changer. Outdoor equipment on the 60 cycle side is seen above. From left to right: dc reactor, 8000 kw self-cooled transformer, 15 kv, 500,000 kva i.c. oil circuit breaker, and 8000 kw self-cooled transformer.



Seen here is a veteran two stand temper pass mill still going strong after 15 years on the job. Allis-Chalmers dc motor drives, supporting synchronous M-G sets, switchgear, and control are employed on one single stand and four two stand tandem temper pass mills doing all the tinplate temper rolling.

15 Year Old Hot Strip Mill



Allis-Chalmers Helps Gary Sheet & Tin Mill Roll 2,377,274 Tons a Year

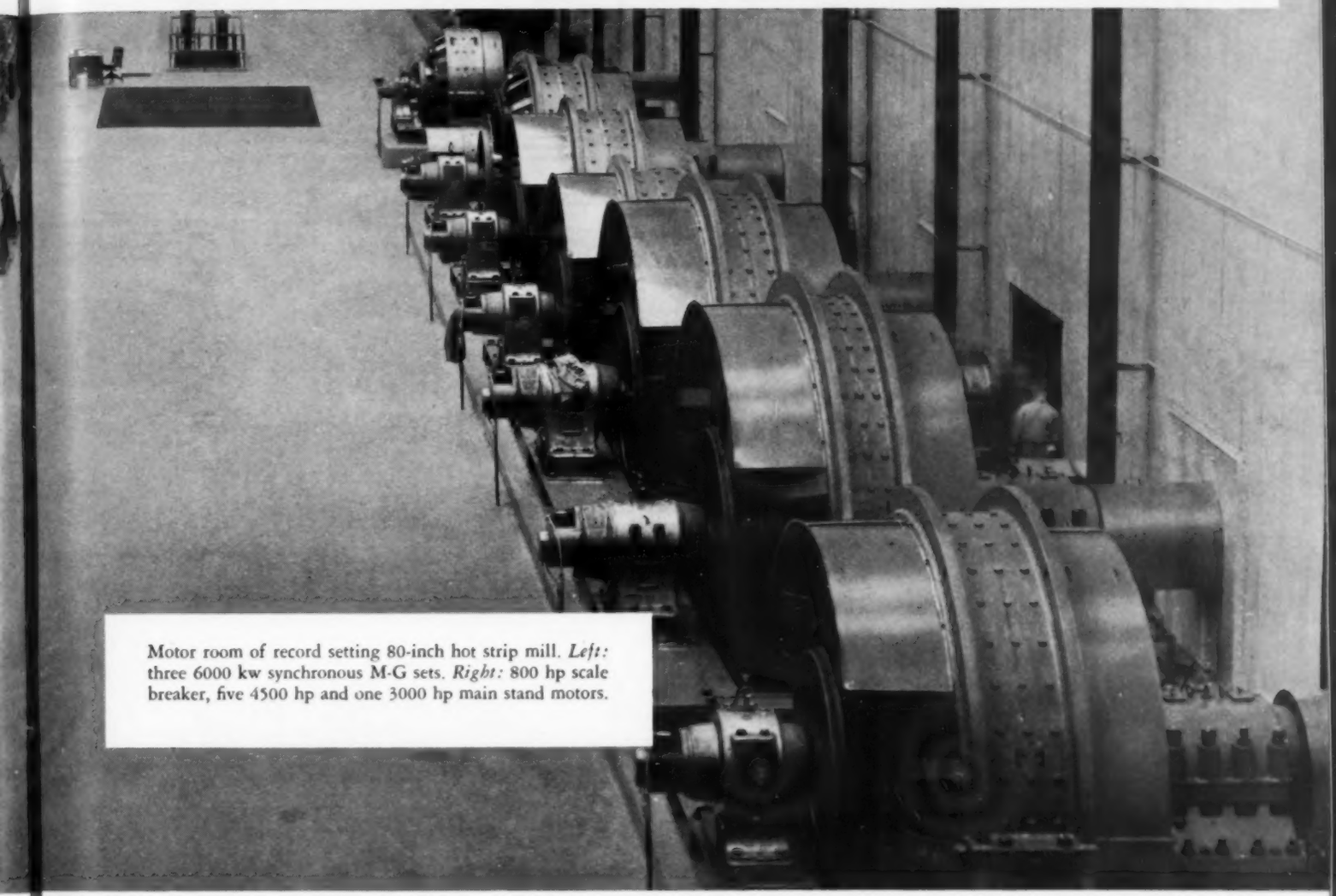
AFTER 15 YEARS IN OPERATION, this 80-inch hot strip mill in 1950 rang up a new annual tonnage world record of 2,377,274 tons! Top 8-hour turn was 4,147 tons. Top month was 222,751 tons. Equipment durability cannot be better demonstrated.

Located at the Gary Sheet and Tin Mill of the United States Steel Company, the mill rolls tough stainless steel as well as strip for regular sheet and tinplate products. Allis-Chalmers supplied the complete electrical equipment driv-

Power, Electrical, Processing Equipment for Iron and Steel

ALLIS-

SETS WORLD TONNAGE RECORD!



Motor room of record setting 80-inch hot strip mill. *Left:* three 6000 kw synchronous M-G sets. *Right:* 800 hp scale breaker, five 4500 hp and one 3000 hp main stand motors.

ing, supporting and controlling this veteran hot strip mill.

Originally installed in 1936, it has since been revamped to meet current demand. But the electrical equipment is still Allis-Chalmers with the original motors, generators and switchgear remaining in operation despite 15 years of punishing shock loads and sustained peak loads!

Allis-Chalmers quality equipment also is displaying durability elsewhere in the Gary Sheet and Tin Mill operation. Five Allis-Chalmers equipped temper mills (lower left) have been in daily operation for 15 years.

First Mercury Pool Frequency Changer

With equipment quality so thoroughly proved, the Gary Sheet and Tin Mill selected Allis-Chalmers to build the first commercial mercury pool type frequency changer in America (upper left). Now in its eighth year, it interchanges power between the 25 cycle system and the 60 cycle purchased power system.

The 16,000 kw electronic frequency changer greatly increases flexibility and economy of operation by permitting full utilization of by-product power and reducing purchased power demand peaks. Other Allis-Chalmers mercury arc rectifiers also are used here to provide 250 volt dc mill supply.

Whatever your needs in electrical equipment for iron and steel production, A-C will supply you with dependable, quality equipment. For specific information on a *complete* range of generation, switching, conversion, rectification, drive, and control equipment . . . call your nearest A-C office or write to Allis-Chalmers, Milwaukee 1, Wis. A-3505

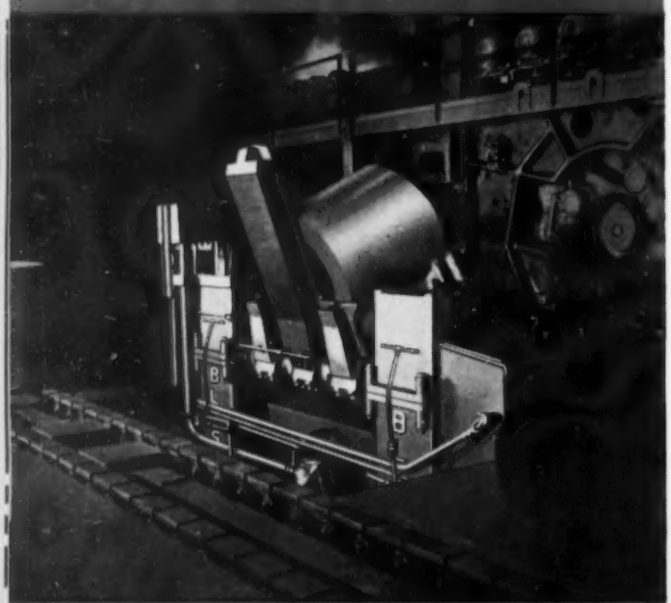
-CHALMERS

A-C ALLIS-CHALMERS

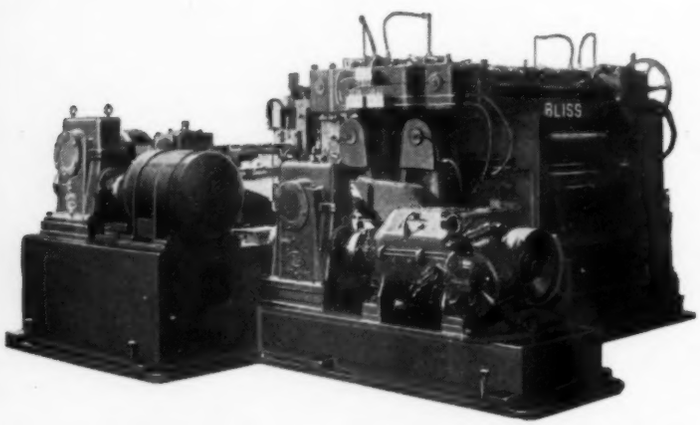
HOW BLISS DESIGNS FOR STEEL, BRASS

PRIMARY METAL PLANTS use hundreds of Bliss special-purpose machines in conjunction with hot and cold reduction mills. In every case, backed by field research with industry's engineers, Bliss has drawn upon its engineering skills to create equipment combining the necessary ruggedness and precision for the job at hand.

Pictured on these pages are typical exam-

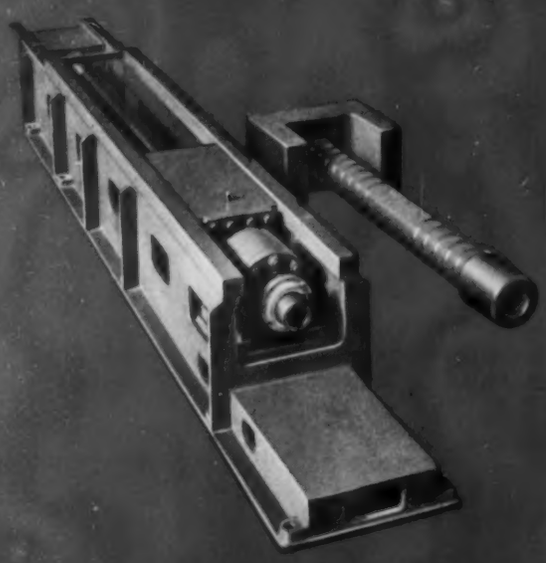


COIL UPENDER strips hot 25,000-pound coils from the Mandrel Coiler, upends and deposits them on a "waffle top," which in turn deposits coils on the moving conveyor strands without damage to coil edges.



13 ROLL BREAKER produces scale-free and inclusion-free product which is suited for final reduction operations.

RUN OUT DELIVERY TABLE specially designed by Bliss has slab sweep-off sections opposite piler. A slab pusher is provided on one side.



ROLL CHANGER WITH SLIDING RAIL permits easy roll removal from the mill and reduces required crane capacity. Balance bar is used to handle work roll assemblies including chocks and bearings.

AUXILIARY EQUIPMENT AND ALUMINUM MILLS

ples of mill accessory equipment designed by Bliss. The complete range is described and illustrated in a new 52-page brochure soon to be published. You can reserve your copy now.

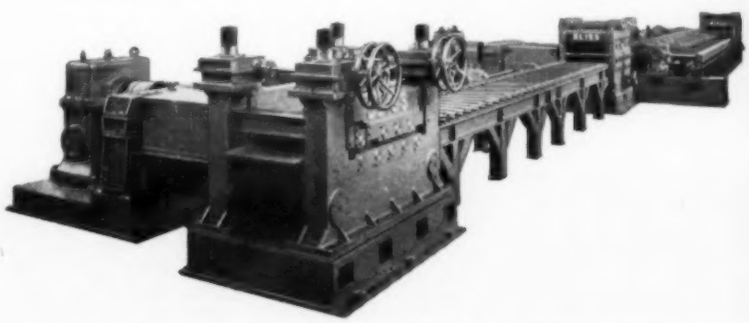
Next time you need auxiliary mill equipment, call in Bliss engineers.

E. W. BLISS COMPANY

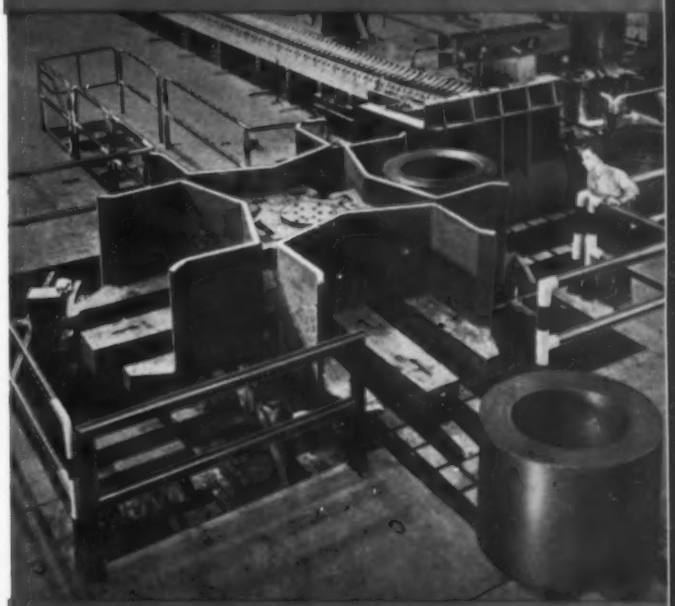
General Office: CANTON, OHIO

Rolling Mill Division: SALEM, OHIO

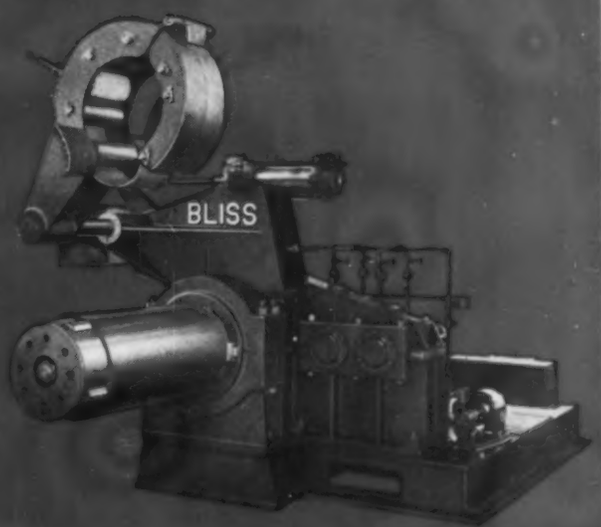
WIDE HORIZONTAL-TYPE BELT WRAPPER is used in conjunction with Tension Reel to coil strip on the fly into tight, uniformly wound coils.



COMBINATION LEVELER AND SLAB MILLER levels the slab, mills one side, turns the bar over and mills the other side. It is used in brass and aluminum mills to prepare metal for final cold reduction.



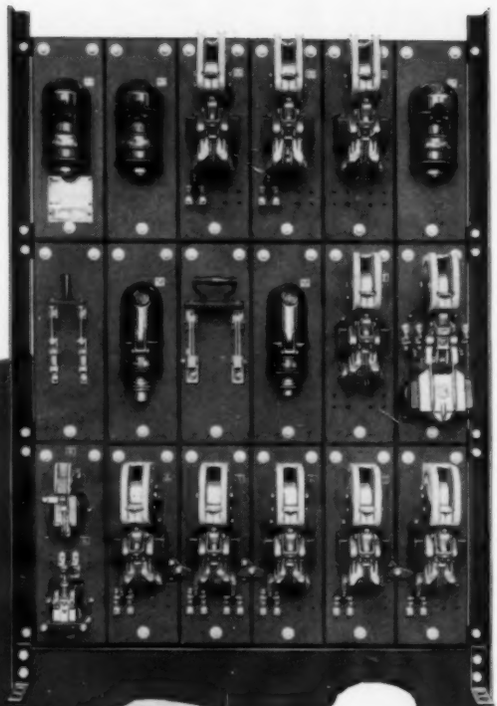
COIL LIFT AND TURN-AROUND UNIT transfers coils weighing up to 30,000 pounds from one leg of conveyor to another. It operates at either 90° or 180°. Perfect coil edges are retained.



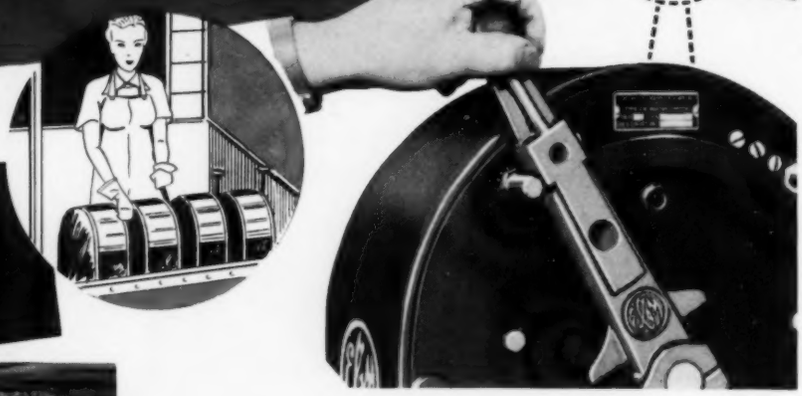
TENSION REEL AND BELT WRAPPER handles 30,000-pound coils. Forced-circulation oil lubrication pump and piping are shown clearly on the typical Bliss gear reduction unit.

8 *Important Features of* **EC&M** *Magnetic Control*

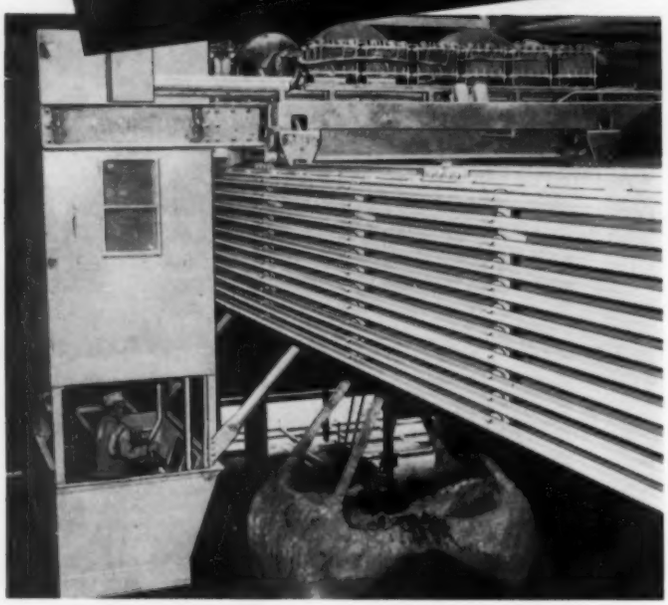
1. Time-Current Acceleration
2. Line-Arc Contactors
3. Wright Hoist Circuit
4. Tab-Weld Resistors
5. Cam Master Switches
6. Safer Electrical Interlocks
7. Bolted, Welded Frame
8. Quick Contact Renewing



NARROW WIDTH, SHORT THROW *Master Switches*



Where easy manipulation speeds output



There's nothing like a 2-motor bucket crane or any extra-motion crane (such as ladle, double-trolley, etc.), to bring out master switch quality and popularity.

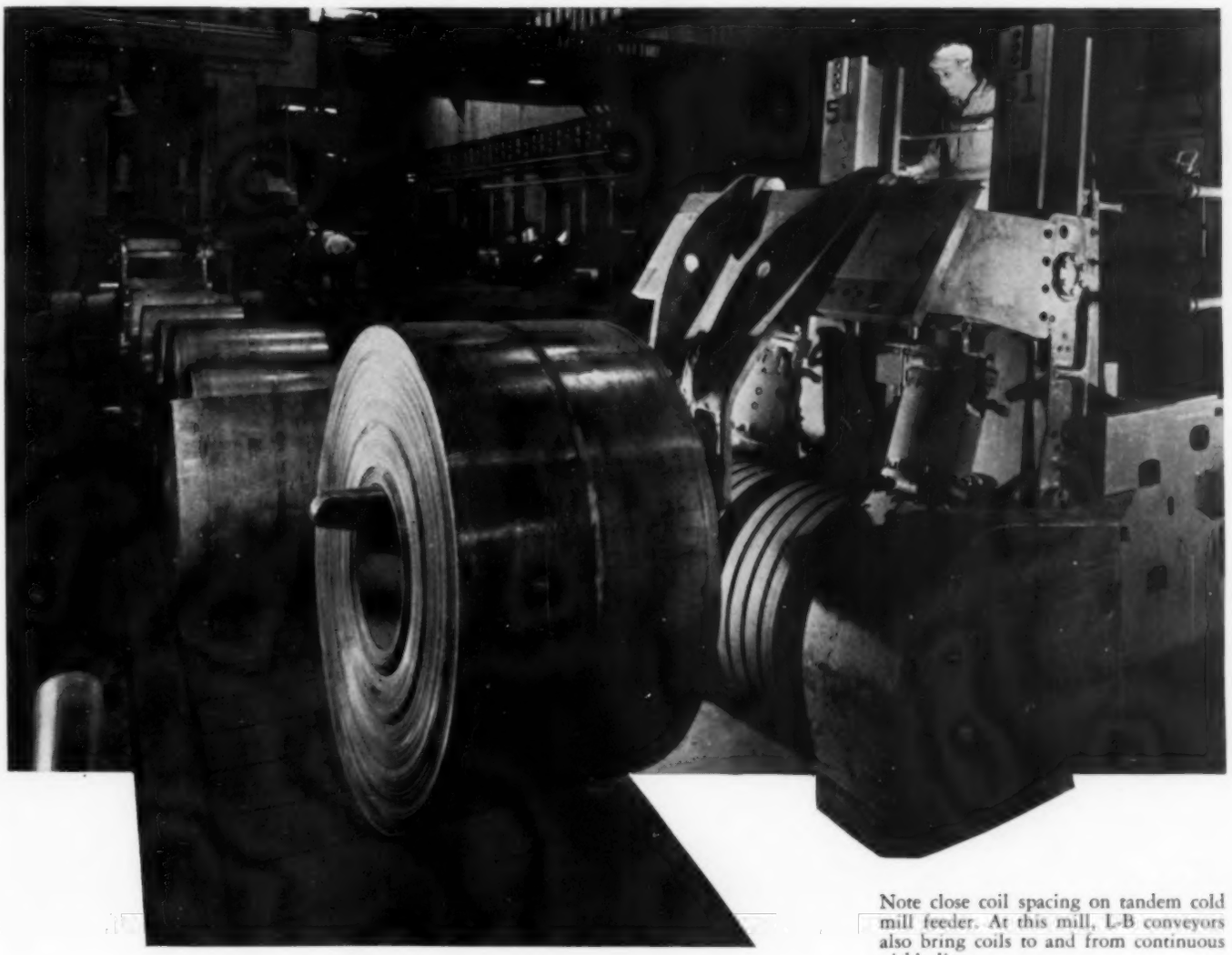
EC&M Cam Masters are popular because they are narrow in width. Several of them can be closely mounted so that an operator can conveniently reach them all without changing position.

Also lightening the task of the operator is the short-throw from off to full-on position of these masters. This materially reduces an operator's movements. Specify EC&M Bulletin 1190-A Cam Master Switches.

THE ELECTRIC CONTROLLER & MFG. CO.
2698 EAST 79TH STREET • CLEVELAND 4, OHIO

YIELD GOES UP...WASTE GOES DOWN

...with LINK-BELT coil handling conveyors



Note close coil spacing on tandem cold mill feeder. At this mill, L-B conveyors also bring coils to and from continuous pickle line.

Pallet feeders keep huge cold reduction mills rolling at high speed

There's no waiting for cranes or trucks when rolling mills are served by Link-Belt feeder-conveyors. That means the rated capacity of a mill can be fully realized.

Equally important, the gentle handling assures less scrap loss. Even on coils weighing as much as 75,000 pounds, there's no telescoping . . . no peening of edges.

Link-Belt builds three different basic designs of coil handling conveyors to meet widely varying physical and economic requirements. Our engineers will work with your own engineers, consultants and builders of mill and process equipment — help you select the right system for your exact needs.

LINK-BELT

MATERIALS HANDLING, PROCESSING and POWER TRANSMISSION MACHINERY

LINK-BELT COMPANY: Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Cleveland 15, Pittsburgh 13, Toronto 8, Springs (South Africa). Offices in principal cities. 12,587

STOP RUST WITH RUST-OLEUM

Why let rust—the most destructive enemy of American I[illegible] —rob you of [illegible]sive, hard-to-repla[illegible] machines, tanks, stacks, fences, pipe, metal sash, fire escapes, and other valuable equipment?

Use RUST-OLEUM in your plant to protect your property. For 25 years RUST-OLEUM has proved its capacity to stop rust for many nationally known manufacturers. Its tough, pliable, rust-resisting film gives excellent protection that prevents rust losses under many difficult rust-producing conditions—salt air, dampness, industrial fumes, and general weathering.

RUST-OLEUM can be applied *even* over rusted surfaces. It is not necessary to remove all the rust. Just remove scale and loose rust by sharp scrapers and wire brushes. You save time and labor on maintenance because no chemical precleaning or sand blasting is usually required.

A qualified RUST-OLEUM specialist will be glad to survey your rust problems and help you develop a program of plant-wide rust control to defer many costly replacements — to conserve the available supply of new metal for national defense.

Industrial Distributors in principal cities of the United States and Canada carry complete stocks for immediate delivery. Plan your needs—order *now!* See our complete catalog in *Sweet's* which also tells the nearest source of supply. Or, write on your company letterhead for full information.

"RIGID ECONOMY, MON!"

Available in many COLORS aluminum and white

Beautifies as it Protects

RUST-OLEUM CORPORATION
2443 Oakton Street, Evanston, Illinois

UNITED

SEMI-CONTINUOUS • FULLY AUTOMATIC *Aluminum Rod Mill*

REG. T.M.

UNITED ENGINEERING AND FOUNDRY COMPANY

Pittsburgh 22, Pennsylvania

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Subsidiaries:

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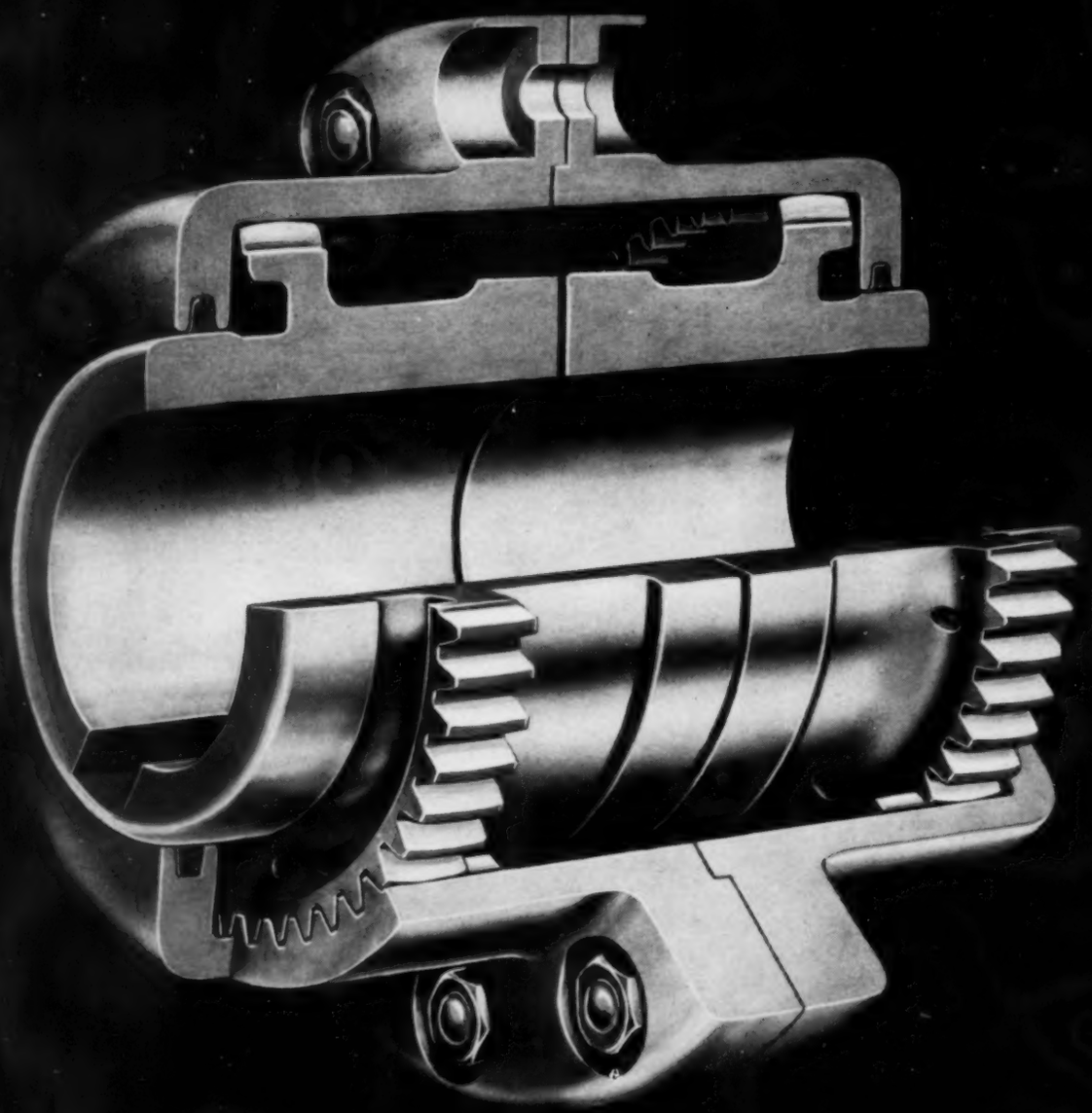
Designers and Builders of Ferrous and Non-Ferrous Rolling Mills, Mill Rolls, Auxiliary Mill and Processing Equipment, Presses and other heavy machinery. Manufacturers of Iron, Nodular Iron and Steel Castings and Weldments.

POOLE



A COPY OF CATALOG GIVING FULL DESCRIPTION AND ENGINEERING DATA SENT UPON REQUEST.

FLEXIBLE COUPLINGS

POOLE FOUNDRY & MACHINE COMPANY

WOODBERRY, BALTIMORE, MD.

for

NATIONAL TUBE COMPANY

Square D controls operate the double spindle coupling screw-on machines for the No. 4 seamless tube mill at the National Tube Company, Lorain Works. These panels illustrate typical tailor-made construction for the specific machines. They incorporate D.C. mill auxiliary control for D.C. motors as well as A.C. control for a hydraulic system involving many electrically operated valves.

Electrical controls for mill machinery become more complex with the demand for more automatic operation and faster production. This trend emphasizes the need for careful circuit design and complete lines of dependable, trouble-free component devices such as Square D has available.

A nation-wide field engineering organization facilitates and coordinates design planning between the user, the machinery builder and the Square D factory. Trained engineers, located in principal cities, are at your service.

Controller above operates double spindle coupling screw-on machines at National Tube Company, Lorain Works.

SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

SQUARE D COMPANY CANADA LTD., TORONTO • SQUARE D de MEXICO, S.A., MEXICO CITY, D.F.

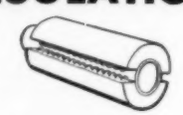
BLOOM Ka-Weld

PRECAST, REINFORCED PIPE INSULATION

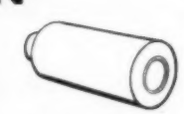
Any furnace change that will save 35,000 cu. ft./hour of natural gas is deserving of serious consideration by furnace operators. Bloom *Ka-Weld* precast, reinforced pipe insulation has brought about such a saving, thereby reducing the demand upon stack, burners and fans—and making possible a 20 tons per hour increase in furnace capacity! Steel is heated more uniformly, skid marks are practically eliminated and slag is greatly reduced.

Made from durable, precast refractory material reinforced with alloy wire mesh, Bloom *Ka-Weld* is easy to install and guaranteed to give satisfactory service. It is manufactured in workable lengths, and can be installed by regular maintenance crews.

Precast lower half section is held in place by welding exposed mesh to pipe.



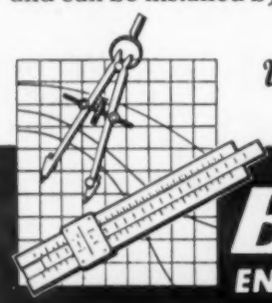
Similarly, the upper half is applied and welded.



The space between the halves is filled with castable refractory.

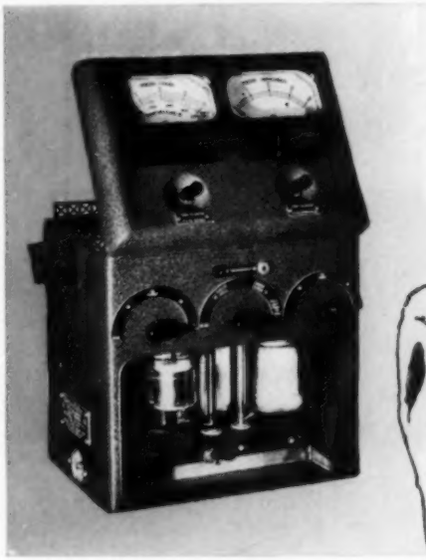
Skid pipes, crossovers and support pipes of underfired furnaces may be completely protected and insulated by KA-WELD Precast Pipe Insulation, thereby reducing fuel rates, increasing furnace capacity and improving steel quality.

Write for Bulletin 2183



BLOOM
ENGINEERING CO., INC.
857 W. North Avenue Pittsburgh 33, Pa.

Not an instrument you buy... but a service we supply



Now *within seconds* you can get an accurate and complete picture of combustion conditions in your furnaces. A Cities Service Combustion Engineer, by applying his *exclusive* Heat Prover, will quickly secure continuous, accurate readings that reveal any oxygen excess or waste combustibles present.

Operators throughout the country, by using these instant readings as their guide, have been improving furnace output and product quality, while saving fuel.

Similar results are possible at your plant. Start the ball rolling today for a FREE Heat Prover test of your furnaces. Simply call or write your local Cities Service office . . . or else return the coupon below.

THE COMPLETE CITIES SERVICE LINE FOR THE METAL FABRICATING INDUSTRY INCLUDES

Chillo Cutting Oils Trojan Greases
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QUALITY PETROLEUM PRODUCTS

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Sixty Wall Tower, Room 158
New York 5, N. Y.

Without obligation please send your booklet, "Combustion Control for Industry."

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NEW SHELL INDUSTRIAL

bring greater under extreme

FOR GEARS...

SHELL MACOMA OILS

FOR ENCLOSED GEARS, Shell Macoma Oils solve the problem of extreme pressure lubrication with *seven distinct advantages:*

1. Extreme load carrying capacity . . . remarkable ability to prevent wear and seizure . . . even after long periods under heavy load.

2. Long-lasting oxidation stability . . . plus freedom from sludge formation in the presence of water.

3. Outstanding adhesion . . . maximum protection against rust, and against leakage through worn bearings and seals.

4. Non-corrosive . . . will not cause corrosion of steel or alloy bearings.

5. Non-Foaming . . . Shell Macoma Oils successfully overcome the tendency to foam caused by aeration of oil in the gear chamber.

6. Speedy water separation.

7. Complete stability in storage and in service . . . no tendency to separate, even in extremes of heat and cold.

SHELL

Be sure to get all the facts about these new Shell Macoma Oils. Check the coupon and attach to your letterhead for full information.

Two great new products of

EP LUBRICANTS

safety to gears and bearings
loads and adverse conditions

FOR BEARINGS...
SHELL ALVANIA EP GREASE

FOR GREASE-LUBRICATED bearings, Shell Alvania Grease . . . the one grease that serves *all* grease applications in the majority of plants . . . *now is available with EP qualities added! . . . now even more Multi-Purpose.*

All of these unique advantages of Alvania Grease are therefore available for the first time to operators of machines subject to extreme bearing pressures:

1. Higher mechanical stability than any conventional grease at operating temperatures.

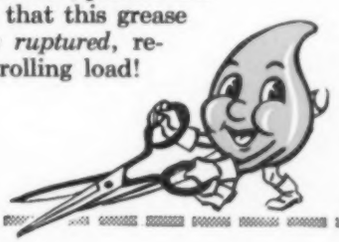
2. Pumpable at low temperatures . . . even through centralized lubrication systems.

3. Stable at high temperatures . . . no phase changes—still a grease at high temperatures—still a grease upon cooling.

4. Resistant to water . . . won't wash out.

5. Longer service life . . . reduced consumption.

Shell Alvania EP Grease is the answer to some of the toughest lubricating problems in industry. In rolling operations, for example, operators of steel, rubber, plastic and paper mills report that this grease film *just won't be ruptured*, regardless of shock rolling load!



Check the coupon and mail today for additional information about Shell Alvania EP Grease.

Shell Oil Company
50 West 50th Street, New York 20, N. Y.;
or 100 Bush Street, San Francisco 6, Cal.

Please send available data on

☐ Shell Macoma Oils ☐ Shell Alvania EP Grease

Name_____

Company_____

Title_____

Address_____

SHELL OIL COMPANY

Improved

SOAKING PIT CRANE

with MULTI-PURPOSE tongs

Here's a rugged, lighter weight Soaking Pit Crane that handles any width slab or ingot. It'll make bottom . . . afford the same visibility as the high rack type Soaking Pit Crane, yet takes up no more head room than a low type Soaking Pit Crane.

Special features include: telescopic ram, all operating mechanism located on deck of trolley, operator's cage on deck of trolley provides best visibility and greatest distance from all sources of heat.

Multi-Purpose Tongs provide gripping range of 6" minimum to 66" maximum opening. Consequently, a much greater range of ingot and slab sizes can be readily handled.

The Multiple Range Tongs can be installed on any model or make of Soaking Pit Crane by Alliance Engineers who will be happy to discuss your specific requirements or give you general information of interest to your industry.

- MAXIMUM RANGE CAPABILITIES
- CRANE REQUIRES MINIMUM SPACE
- AFFORDS MAXIMUM VISIBILITY
- ALL MECHANISM EASILY ACCESSIBLE
- KEEPS OPERATOR AWAY FROM HEAT

THE ALLIANCE MACHINE COMPANY

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ALLIANCE, OHIO

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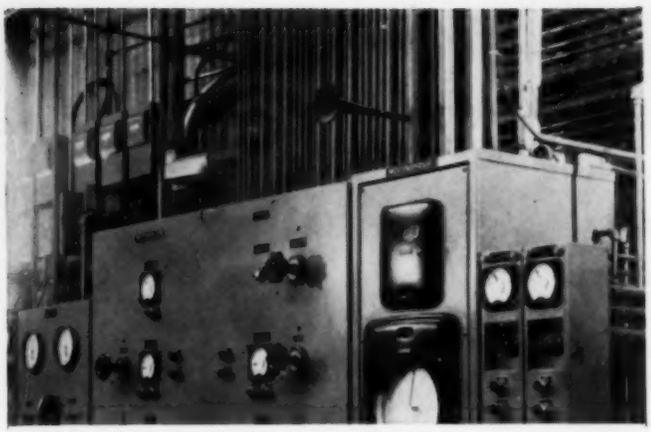
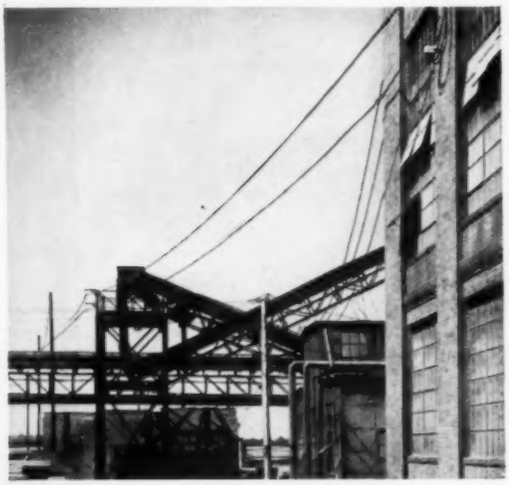
1622 OLIVER BUILDING, PITTSBURGH, PA.

LADLE CRANES • GANTRY CRANES • FORGING MANIPULATORS • SOAKING PIT CRANES • STRIPPER CRANES • SLAB AND BILLET CHARGING MACHINES • OPEN HEARTH CHARGING MACHINES • SPECIAL MILL MACHINERY • STRUCTURAL FABRICATION

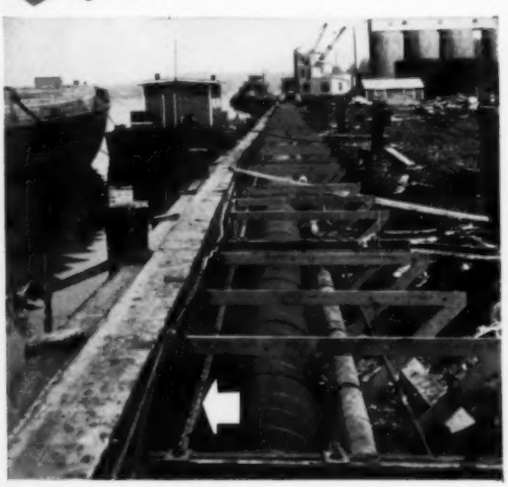


Maze of conduit carries Okolite-Okoprene control and power wiring from control panel to Kamyr Pulp Drying Machine. A major portion of the equipment in the motor generator substation is also controlled from this switchboard.

Motor generator room, showing 2300 entrance breakers, 550-volt distribution breakers, motor generator set and electronic speed regulator cubicles. All of these, both a-c and d-c, are fed by Okolite-Okoprene cable.



Okolite-Okoprene self-supporting aerial cables distribute power to transformer sub-stations from the Power House. "Stormsafe" aerial cable eliminates congestion, reduces clearance problems, and provides triple economy of quick installation, low maintenance costs and better voltage regulation.



why it pays to use OKOLITE-OKOPRENE CABLES *throughout* THE JOB

The Story of an Okolite-Okoprene Installation at a Large Southern Pulp & Paper Mill

MORE and more electrical engineers are specifying OKOLITE-OKOPRENE cables for complete installations. For when every electrical circuit on a job is OKOLITE-OKOPRENE, the degree of circuit security on that job is unequalled.

OKOLITE-OKOPRENE is especially suitable for complete installations because of its versatility. Highly resistant to every element which attacks cable, OKOLITE-OKOPRENE is used in wet, dry, hot or cold locations—exposed to weather or sunlight—underground or in conduit.

For instance, a large pulp manufacturer made extensive use of OKOLITE-OKOPRENE in installing a Kamyr Pulp Drying Machine. Power and control circuits, leads for the battery of synchronized generators and motors and circuit breakers, self-supporting aerial cable from sub-stations to the Power House – even push-button stations and the lighting system were OKOLITE-OKOPRENE.

The Company engineers selected OKOLITE-OKOPRENE throughout this job because of the necessity of keeping the Kamyr Machine in continuous operation. Resistant to moisture, heat, sunlight, oils, acids, ozone and chemicals, OKOLITE-OKOPRENE is the most economical and reliable way of supplying electrical power to key operations. The Okonite Company, Passaic, N. J.

THE BEST CABLE IS YOUR BEST POLICY

OKONITE OKONITE SINCE 1878 *insulated wires and cables*

9295

RUGGED

KEYSTONE INSULATORS STAND HEAT...WEATHER...SHOCK

Current for ingot buggies must be maintained under the most rugged operating conditions of heat, cold and shock. That's why Keystone Contact Rail Insulator Type DDI is so extensively used by many of the nation's largest steel mills.

The heavy glazed semi-porcelain block of this insulator provides reliable support and insulation of contact rails. Malleable iron cap cemented to block is equipped with adjustable lugs adaptable to standard rails from 30 to 65 lbs. (Type DD to 95 lbs.). Ease of installation is accomplished with a single mounting bolt.

Throughout the nation—on cranes, conveyors and other electrical hoisting and handling systems—the Keystone Line of Insulators and Collectors is providing positive power for moving contacts in leading steel mills. Details on the complete line are available in the new Keystone Catalog. Write for your copy.

KEYSTONE UNDER-CONTACT RAIL SYSTEM

Assembly No. 45813 for supporting two rails where two conductors are required—for multi-phase work or remote control operation.

KEYSTONE CONTACT RAIL INSULATOR

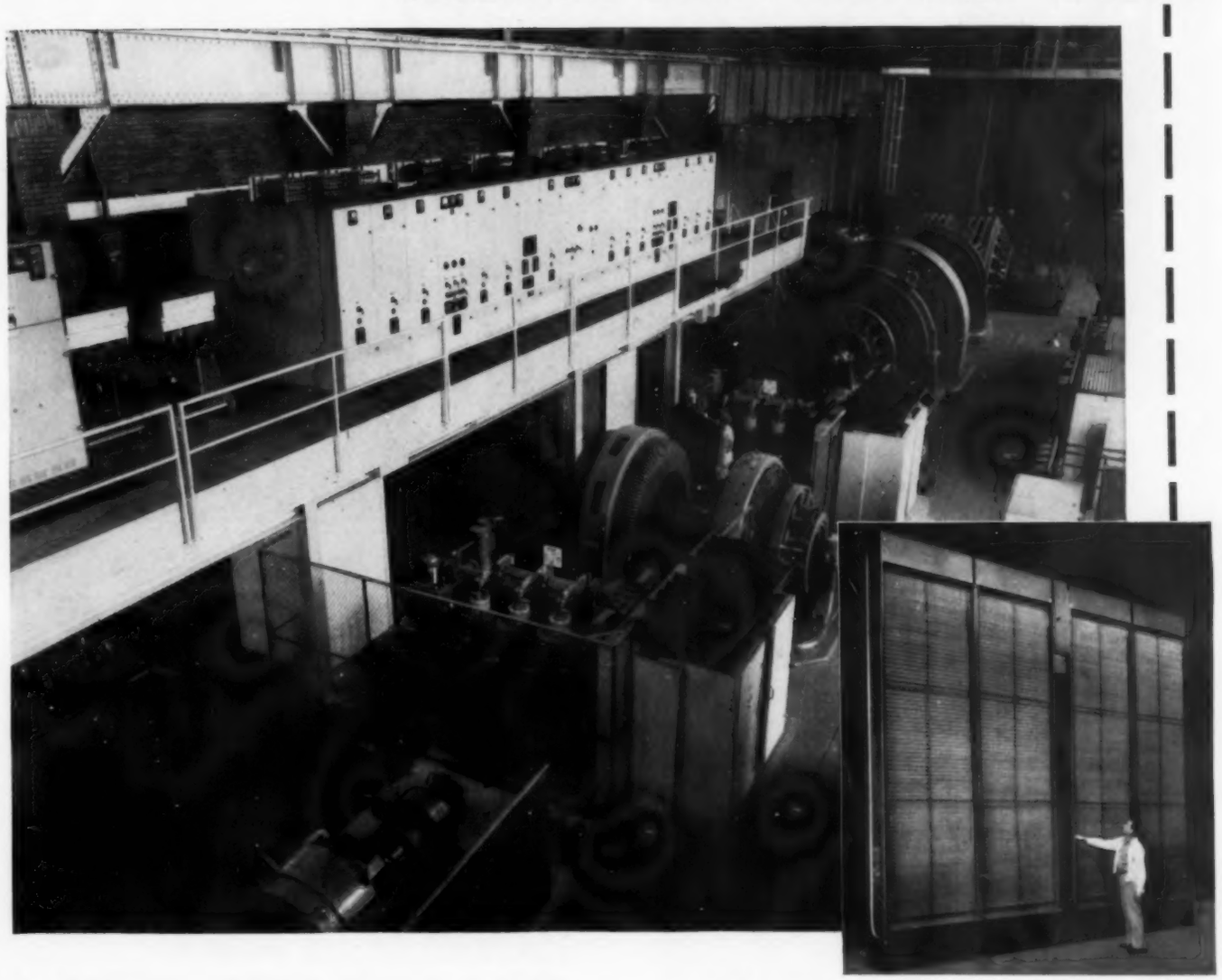
Type HA for over-running contacts. Permits free movement of rail . . . providing for contraction and expansion due to temperature.

ELECTRIC SERVICE MANUFACTURING CO.

PHILADELPHIA 32, PENNA.

MANUFACTURERS OF COMPLETE LINE OF INSULATOR SUPPORTS FOR RAIL AND WIRE CONDUCTORS AND CURRENT COLLECTION DEVICES

clean air costs less than dust!



4 Section Multi-Duty Air Filter. Capacity 105,000 C.F.M., with intermediate drive.

dust can't damage these motors!

AAF Multi-Duty Filters Supply Clean Air for Blooming Mill Motor Room

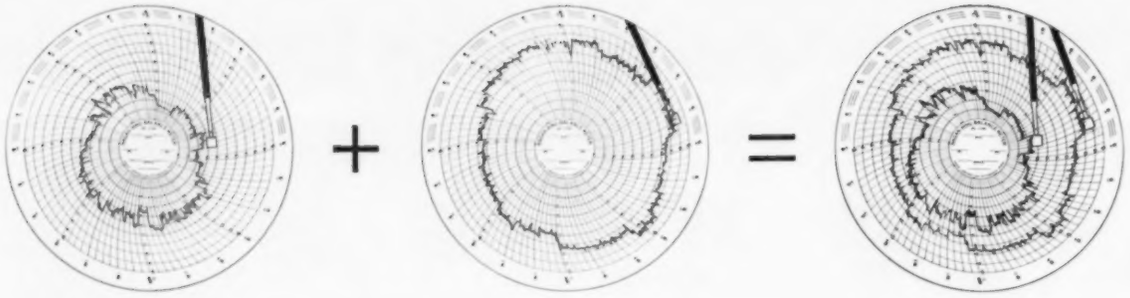
This blooming mill motor room in a large steel plant has clean air protection supplied by AAF's Multi-Duty filters. Clean air is important to mill motor efficiency . . . and to save motor wear. These self-cleaning filters insure long motor life, maximum efficiency . . . reduce both shutdowns and maintenance on motors . . . for a small percent of motor cost.

The Multi-Duty is an ideal filter for this type of application where constant clean air volume is required. It is fully automatic and self-cleaning . . . assuring maximum operating efficiency at all times without dependance upon the human element. The exclusive principle of overlapping panel construction in the Multi-Duty was introduced by AAF in 1927. It is still the most practical method of combining the function of self-cleaning with the operating cycle. Although there have been many improvements in the design of individual panels and in construction, this basic principle has never been surpassed.

For a sound investment in motor protection write today for Multi-Duty Engineering Bulletin No. 241B.

AAF American Air Filter COMPANY, INC.

302 Central Ave., Louisville 8, Kentucky • In Canada: Darling Brothers, Ltd., Montreal, P. Q.



Dependable Measurement

is assured with HAGAN

RING BALANCE METERS

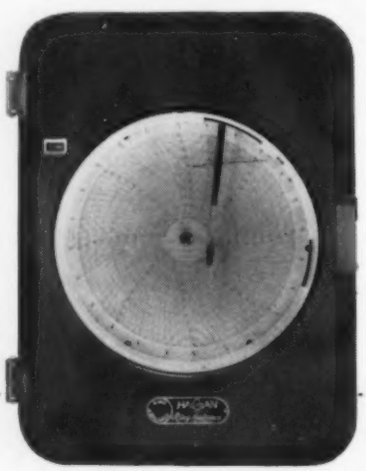
COST DISTRIBUTION is easy when the sum of individual flows equals the total flow — and records and totalized flows *are dependable* when made by Hagan Ring Balance Meters.

STANDARD ASSEMBLIES are available for measuring flow differentials up to 420″ water column at 3000 psig.

DUAL METER ASSEMBLIES give two records of flow differentials, each up to 140″ water column at 3000 psig.

AUTOMATIC COMPENSATION for pressure or temperature, or both, may be added.

For more information about Hagan Ring Balance Meters, clip the coupon.



FEATURES OF ALL HAGAN RING BALANCE METERS INCLUDE:

- ★ **No Stuffing Boxes**
- ★ **Mercury level not critical**
- ★ **Dead-weight calibration under full static pressure**
- ★ **Full scale differential range adjustable over 7-to-1.**

HAGAN CORPORATION

RING BALANCE FLOW AND PRESSURE INSTRUMENTS
THRUSTORQ FORCE MEASURING DEVICES
BOILER COMBUSTION CONTROL SYSTEMS
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Please send me further information on Hagan Ring Balance Meters. I am particularly interested in.....

NAME.....

POSITION.....

COMPANY.....

STREET AND NUMBER.....

CITY..... ZONE..... STATE.....

IS-10

THE BIG 89% TELLS YOU WHY A YALE ELECTRIC TRUCK IS YOUR BEST BUY

89% of the Yale Electric Trucks sold today are bought by previous users...so satisfied with Yale performance and Yale economy that Yale is their choice again.

•Seeing that extraordinary record—you'll say these must be extraordinary trucks. And they are!

They bring to your materials handling problems new shortcuts—new savings in man-hours—new opportunities to answer today's stepped up demands for increased production and faster deliveries.

In many businesses Yale Electric Trucks are completely amortized in a relatively short time—and then pay for themselves many times over during their long years of service.

Rugged Yale quality—built into every part—explains the service these trucks give even in the toughest jobs . . . even when working on round-the-clock schedules that would knock out trucks of less durable construction.

Ask for complete details about Yale Electric Trucks—and their industry-wide record of satisfied users.

YALE & TOWNE

The Yale & Towne Manufacturing Co., Philadelphia 15, Pa.

YALE is a registered trade mark of the Yale & Towne Manufacturing Co.

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Roosevelt Boulevard & Haldeman Ave., Philadelphia 15, Pa.

I am interested in cutting my materials handling costs.

☐ Please have your local representative call on me.
☐ Please send me free detailed literature.

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In Canada write: The Yale & Towne Manufacturing Company, St. Catharines, Ontario

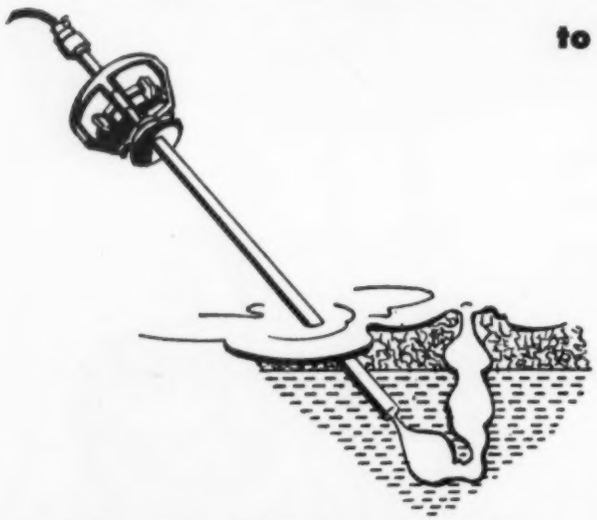
YALE GAS AND ELECTRIC INDUSTRIAL TRUCKS • YALE WORKSAVERS • YALE HAND TRUCKS • YALE HAND AND ELECTRIC HOISTS

For more profitable heats

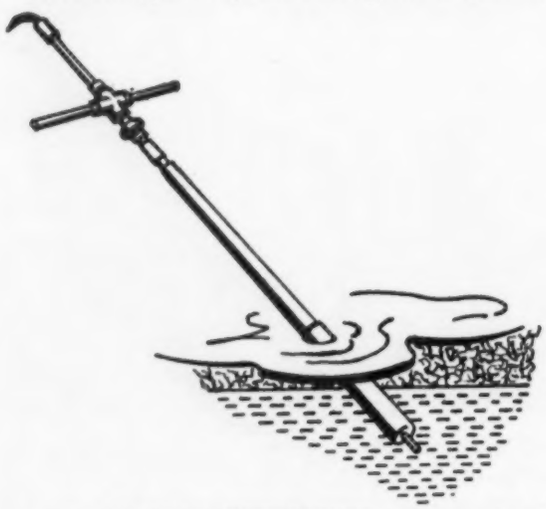
choose

IMMERSION RAYOTUBE or IMMERSION THERMOCOUPLE

to measure temperatures in the steel bath



THE IMMERSION RAYOTUBE is plunged beneath the surface of the bath . . . sights on an air pocket blown in the steel . . . reports temperature to a Speedomax Recorder.



THE IMMERSION THERMOCOUPLE is immersed until couple reaches bath temperature . . . a process guided by signal lights and charted on a Speedomax Recorder.

Open hearth and electric furnace shops can now choose between *two* tested L&N methods for measuring steel temperatures during the melt. Either the Immersion Rayotube or Immersion Thermocouple is plunged momentarily beneath the surface to measure the interior temperature of the bath, while a dependable Speedomax Recorder displays the information where all concerned can use it.

Either method helps improve ingot production by warning if the steel is too hot or too cold for normal pouring. Authorities* have found that some ingots from as many as 44% of overheated melts will stick to the molds, resulting in loss of production time, while as many as 52% of underheated melts will lose yield through formation of skulls in the ladle. *Both of these losses have been sharply cut in every plant where temperature is properly measured while the melt is finished off for tapping.*

Investigate the choice of immersion methods L&N offers to meet plant requirements. *In general,* Rayotubes are employed in heavy-duty shops where several readings may be taken every hour, while thermocouples—although sometimes preferred for such service—find wider application to small or special furnaces. However, a number of factors determine the final choice. Let our experienced engineers analyze your measurement problems and help your staff select the proper equipment.

Contact our nearest office, or write us at 4942 Stenton Avenue, Philadelphia 44, Pa.

* Clark and Feigenbaum of J&L, in AIMME Technical Paper 2031.

LEEDS NORTHRUP

Jrl Ad N-33-640(2)

Big blast furnace blower by ELLIOTT

One of the largest of its kind, this multi-stage centrifugal blower is one of two recently installed in an Ohio steel mill. Each blower is rated 100,000 cfm, at 30 psig, and is driven at 2660 rpm by an Elliott 11,000-hp steam turbine.

Elliott centrifugal blowers are custom-built to the requirements of the installation. They are characterized by unusually rugged construction throughout. Advanced welding design and technique produce a closed type blower impeller of very smooth but heavy construction. The multi-stage driving turbine is of most modern design. Several recent, authenticated records for uninterrupted service and minimum maintenance prove the superiority of Elliott construction.

Elliott blowers are built complete with driving unit, assembled and tested in the Elliott plant. Any required type of drive may be used — turbine, motor, or motor geared.

HALF CENTURY OF POWER PROGRESS 1901 EC 1951

ELLIOTT Company

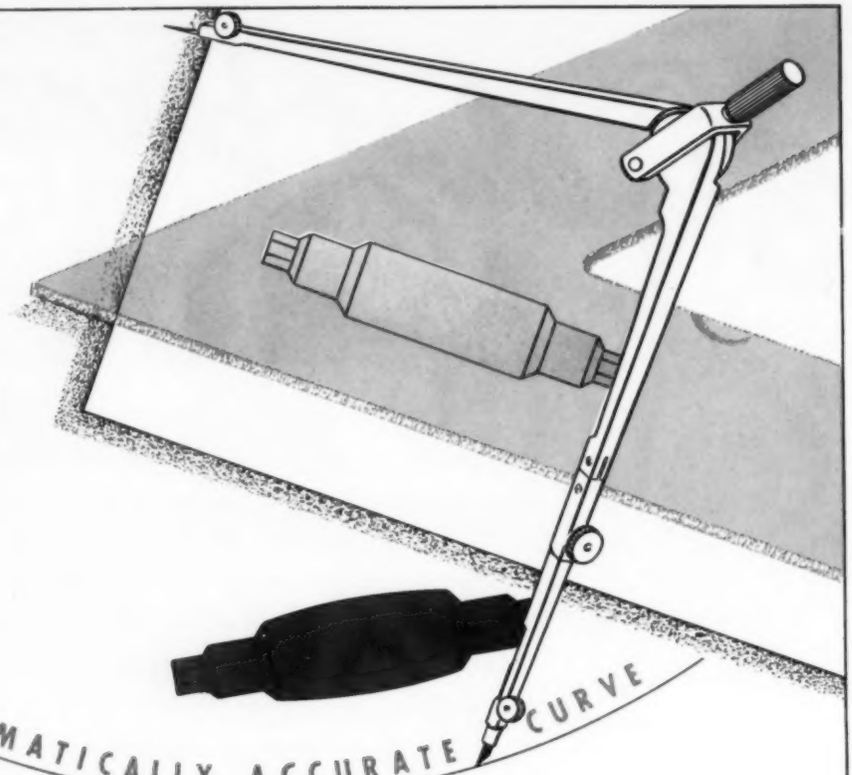
CENTRIFUGAL BLOWER DEPT. • JEANNETTE, PA.

Plants at: JEANNETTE, PA. • RIDGWAY, PA. • AMPERE, N. J. • SPRINGFIELD, O. • NEWARK, N. J.

DISTRICT OFFICES IN PRINCIPAL CITIES

P-1094

HOW TO GRIND YOUR ROLLS WITH A



MATHEMATICALLY ACCURATE CURVE

A Farrel roll grinders are available in two types — type HD shown here, and type TT with traveling work table. Bulletins giving complete specifications of either type will be sent promptly on request.

B Farrel patented automatic crowning and concaving device.

If you are having trouble in obtaining a truly accurate crowned or concaved contour on your rolls, a Farrel grinder will provide the solution to your problem.

Farrel roll grinders are equipped with an automatic device, a built-in "brain," which guides the grinding wheel along a perfectly graduated, mathematically accurate curve. Crowned or concaved rolls are ground with both halves perfectly symmetrical.

This device is the adjustable, single eccentric type, designed for ease and simplicity of setting. It assures exact synchronism between wheel carriage and wheel.

The same setting invariably produces exactly the same curvature, permitting uniform and easily controlled accuracy of contour in all rolls.

Accurate "curve control" is only one of the many outstanding features of Farrel roll grinders. Write for descriptive bulletin.

FARREL-BIRMINGHAM COMPANY, INC., ANSONIA, CONN.

Plants: Ansonia and Derby, Conn., Buffalo, N. Y.

Sales Offices: Ansonia, Buffalo, New York, Pittsburgh, Akron, Chicago, Los Angeles, Houston.

Farrel-Birmingham®

FB-706

today piping repairs cost more!

Crane No. 465½
Iron Body Gate Valve

You make fewer of them

by using Dependable Quality

CRANE VALVES

...That's why more Crane Valves are used than any other make

No bonnet joint trouble with this valve

A typical example of low-cost maintenance—Crane No. 465½ 125-Pound Iron Body Gates. Rarely does the bonnet joint need attention. Flange construction includes reinforcement to prevent distortion and utilizes more bolts, more closely spaced, than is usual in valves of this class. Crane precision-guided seating reduces seat and disc wear. Packing has long life because these valves have a deep stuffing box filled with high grade asbestos ring packing. A ball-type gland helps to equalize the packing load.

Better performance features like these make Crane the better buy in valves of every type. They assure low maintenance cost—low ultimate valve cost—for every piping service.

CRANE CO.

General Offices:
836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

Rely on Quality

INDUSTRIAL

PYLE-NATIONAL LIGHTING FIXTURES

for longer service life, added Safety and Efficiency

EXPLOSION-PROOF

Pyle-National LE Series (Class 1, Groups C and D)

For use in locations where highly flammable materials are manufactured or handled.

Rugged, flame-tight cast aluminum alloy housings render internal explosions harmless, and insure safe operating temperatures. Threaded construction permits easy access to interior for wiring and lamp replacement. Available in many types and sizes.

DUST-TIGHT

Pyle-National DE Series (Class II, Group E, F, G and Class III)

For use in locations where flammable dusts are present in quantity.

Strong, one-piece cast aluminum alloy housings are designed to exclude dust from the interior and to avoid accumulation of dust on the exterior surface. Available in many types and sizes.

VAPOR-TIGHT

Pyle-National BO Series

For use in any outdoor or indoor location subjected to heavy concentrations of non-flammable vapors, gases, dusts, or moisture.

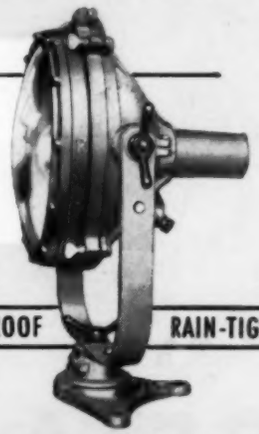
Heavy duty construction and especially efficient sealing features insures an exceptionally long service life. Full line for 10 to 200 watt lamps.

VAPOR-TIGHT SIGNAL OR PILOT LIGHTS

Midget Fixtures for 10 watt Lamps.

ENCLOSED FLOODLIGHTS

Sealed against moisture and dirt, constructed throughout of cast aluminum and other rugged, corrosion-proof materials, Pyle-National floodlights retain their original high-efficiency output throughout an exceptionally long service life, with negligible maintenance and replacement expense.



WEATHER-PROOF RAIN-TIGHT

SINCE 1897

THE PYLE-NATIONAL COMPANY

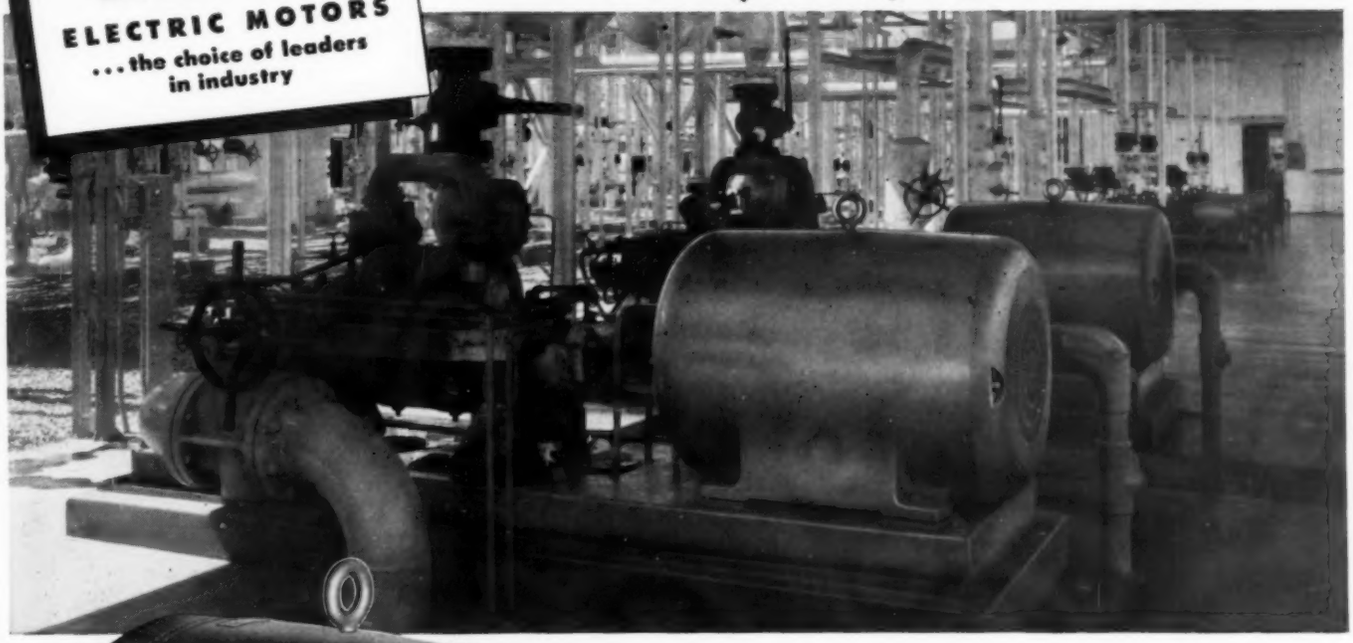
1383 N. KOSTNER AVENUE • CHICAGO 51, ILLINOIS

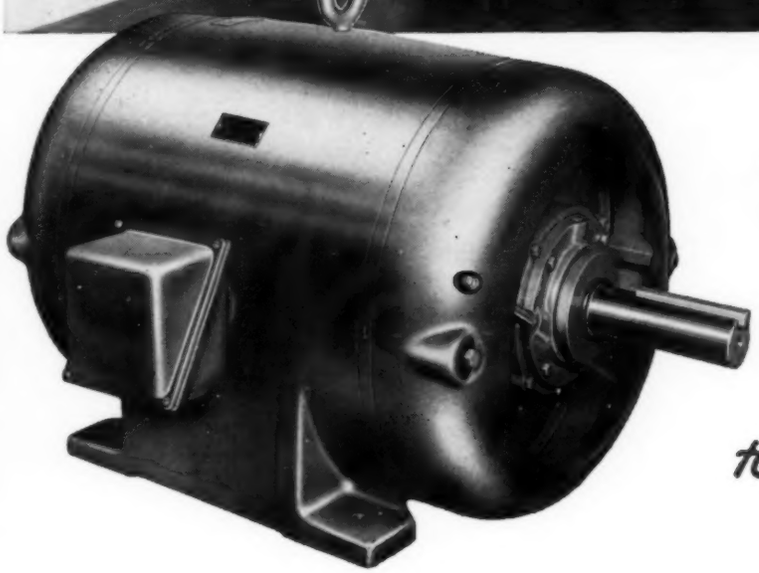
District Office and Representatives in Principal Cities of the United States. Export Department: International Railways Supply Co., 30 Church St., New York. Canadian Agent: The Holden Co., Ltd., Montreal, Toronto, Winnipeg, Vancouver.

CONDUIT FITTINGS • PLUGS AND RECEPTACLES • TURBO-GENERATORS • GYRALITES • MULTI-VENT AIR DISTRIBUTION

Wagner
ELECTRIC MOTORS
...the choice of leaders in industry

Built for your protection...





Wagner

Cast-Iron Frame MOTORS

totally enclosed...fan cooled ...corrosion-resistant

These totally-enclosed fan-cooled motors are built to take it—destructive elements, dirt or dust, acids or fumes don't interfere with their dependable operation.

Wagner cast-iron motors are especially suitable for installation in steel mills, mines, chemical plants, refineries and for other applications where corrosion is a problem, because practically all exposed parts are made of heavy, corrosion-resistant cast iron.

Where protection against explosive atmospheres is required, an explosion-proof design (type JP) can be furnished. Both the standard totally-enclosed type and the explosion-proof type are available in ratings from 2 to 250 horsepower, with either normal torque or high torque characteristics.

Wagner's new Bulletin MU-132 gives complete information on these fully-protected motors. Write for your copy today. Thirty-one branch offices, located in principal cities, are ready to assist you in any motor application problem.

WAGNER ELECTRIC CORPORATION
6483 Plymouth Ave., St. Louis 14, Mo., U.S.A.

®Wagner Electric Corporation 1891 WE 1951

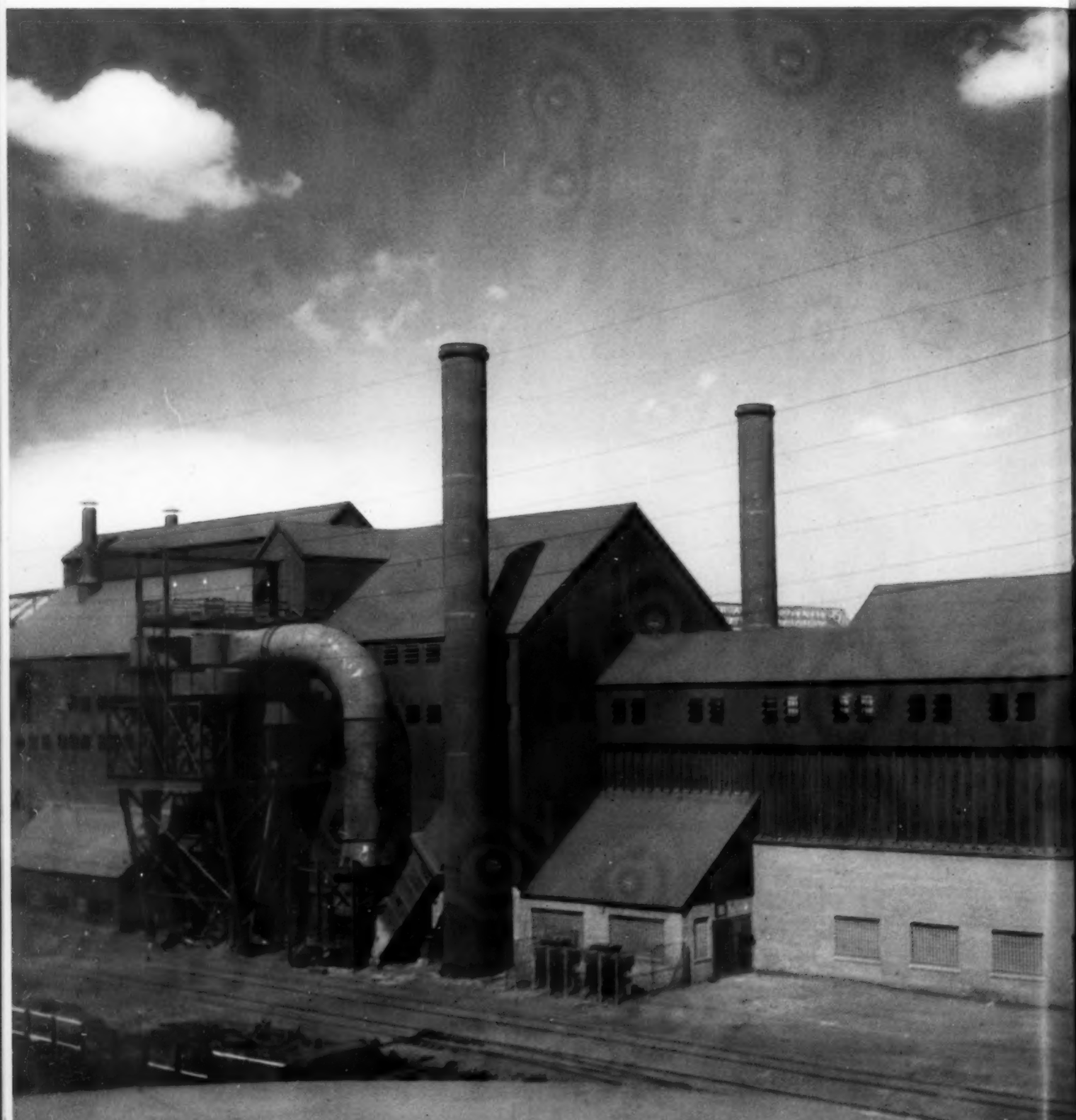
ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS – AIR AND HYDRAULIC

BRANCHES IN 31 PRINCIPAL CITIES

M51-10

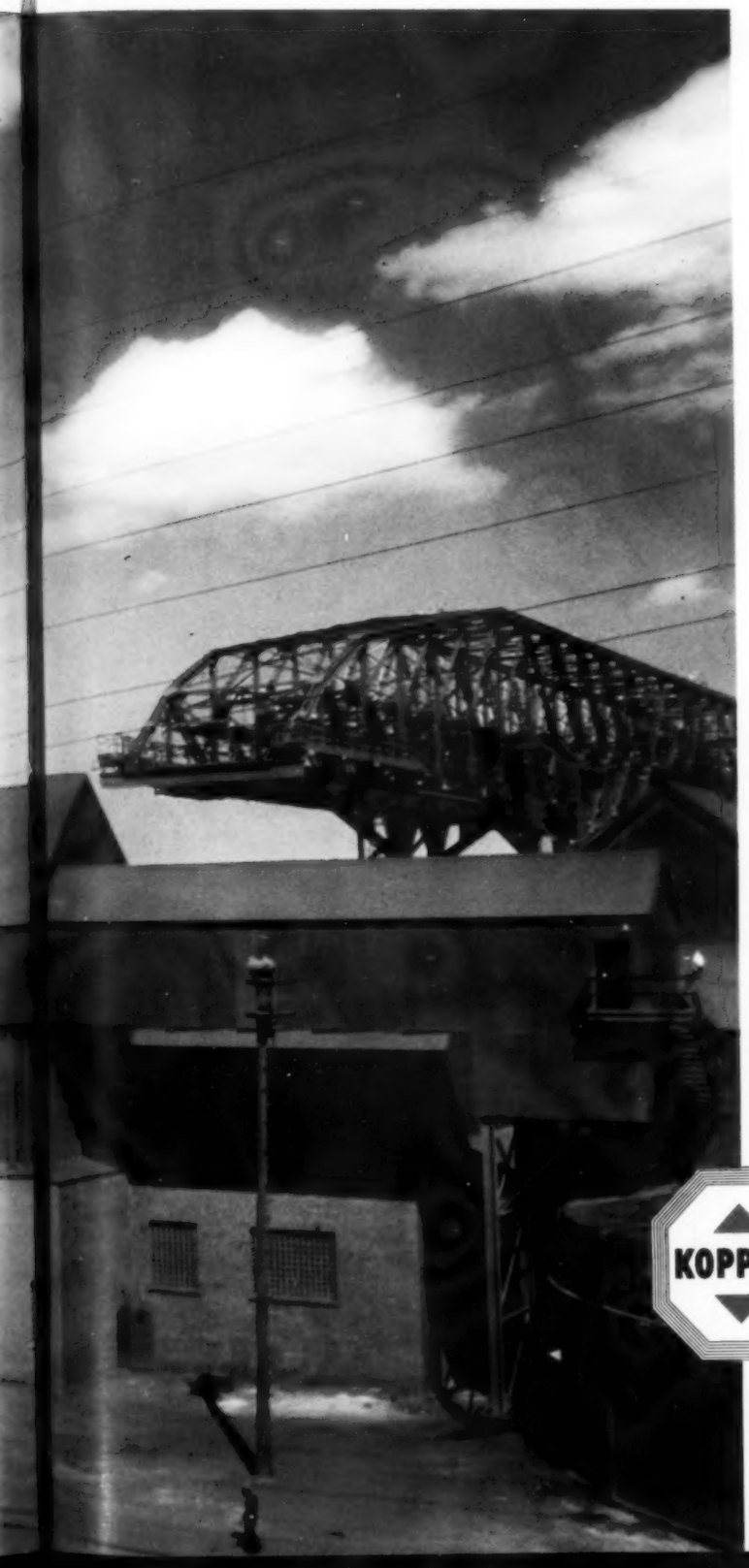
MODERN SINTERING PLANT... bu

PRODUCING GOOD QUALITY SI



built for United States Steel

SINTER FOR BLAST FURNACES



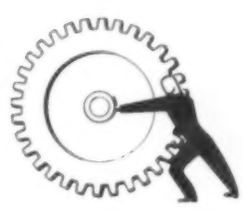
OUR nation's steel mills are shattering all production records, trying to meet the terrific demands for steel. And, at the same time, every steel mill must squeeze the most out of every ton of iron ore. There's no place for waste in this critical period.

The sintering process therefore becomes more important than ever; it permits the *maximum* utilization of iron-ore fines and blast-furnace flue dust. Also, sintering has a decided effect on blast-furnace operation—making output greater, coke rate lower, and action smoother.

The modern sintering plant, pictured here, was built in 1950 by our Freyn Engineering Department for the Gary, Indiana, Plant of the United States Steel Company. This Freyn-Design Plant has two sintering machines. Being extremely flexible in operation, this plant can use various percentages of iron-ore fines and flue dust in producing ferrous burden.

Constructing sintering plants is just one way in which Koppers serves the steel industry. For any kind of metallurgical construction, *you can count on Koppers.* You are invited to consult with our Engineers and Management.

PUT YOUR SHOULDER TO THE WHEEL
SEND IN SCRAP TO MAKE MORE STEEL!

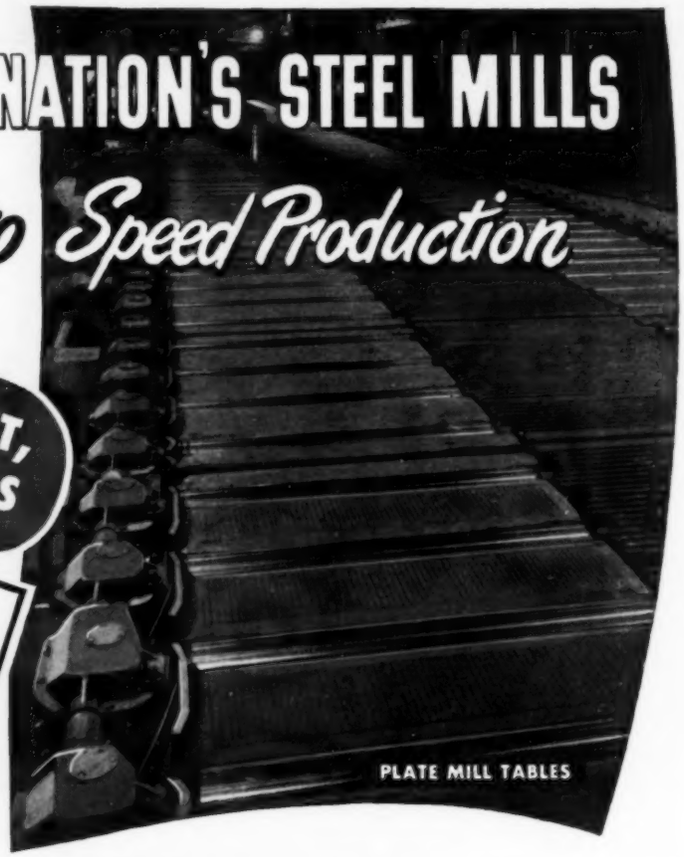


KOPPERS

Engineering and Construction Division

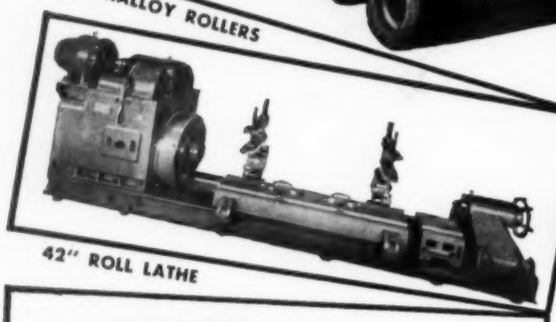
KOPPERS COMPANY, INC. • PITTSBURGH 19, PA.

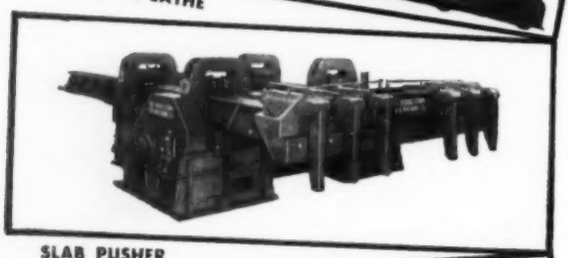
F&Ym EQUIPS THE NATION'S STEEL MILLS to Speed Production

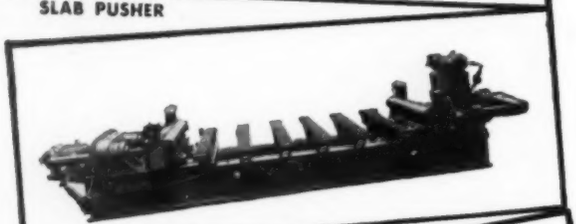


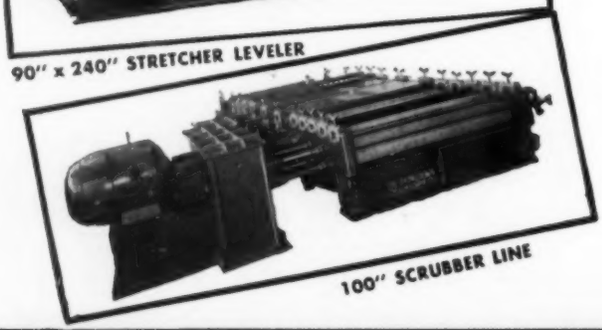
MACHINES, EQUIPMENT, ROLLS AND CASTINGS

PARALLOY ROLLERS


42" ROLL LATHE


SLAB PUSHER


90" x 240" STRETCHER LEVELER


100" SCRUBBER LINE

Check this List for the Products You Need

- PARALLOY ROLLS (Pinch, Coiler, Tension, Steel Mill)
- HYDRAULIC SLAB AND BILLET PILERS
- STRIP AND SHEET OILING EQUIPMENT
- SHEET SCRUBBER AND CLEANING LINES
- HOT SAWS—ROCKING AND SLIDE TYPES
- HOT BEDS—COOLING BEDS—TRANSFERS
- BILLET EJECTORS—PINCH ROLL STANDS
- SLITTERS—SPECIAL SHEARS AND GAUGES
- TILTING TABLES—Traveling and Lifting Tables
- Continuous PICKLING Lines—ROLLER LEVELERS
- FURNACE Charging Equipment—Furnace Pushers
- Strip Steel COILERS and REELS—SCRAP BALLERS
- RAILROAD Spike Forming Machines—ROLL LATHES
- Sheet GALVANIZING Lines—Wire Patenting Frames
- Stretcher Levelers—Angle and Shape Straighteners
- Rolling Mill Tables—Gear and Individual Motor Types
- DUCTILE CASTINGS (80,000 PSI.)

Machinery Built to Customer's Design and Detail Drawings

The Youngstown Foundry & Machine Co.

OVER SIXTY YEARS OF SERVICE TO THE STEEL INDUSTRY

Youngstown, Ohio

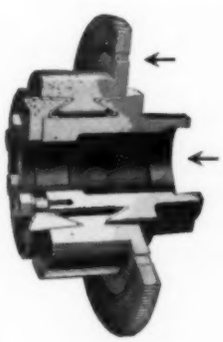
RELIANCE
TYPE 'T' HEAVY DUTY D-C. MOTORS

THE TOUGHEST MOTORS EVER BUILT...

Completely assembled Type 'T' armature, Reli-X insulated and dynamically balanced.

because since the building of the first Type 'T' D-c. Motor nearly 50 years ago, users have contributed from their experience to help Reliance engineers increase the stamina of the Type 'T' design to meet the most grueling service conditions encountered in industrial applications.

Heavy duty armatures, for example, feature cores of high-grade silicon steel punchings and shafts which have been finish-ground to assure accurate fits. All armatures are Reli-X insulated and dynamically balanced. High-riser type commutators are designed and built to meet overspeed requirements. Further facts about the heavy duty construction of armatures and other vital parts of Reliance Type 'T' D-c. Motors are detailed in Bulletin C-2001. Write for this handy reference which also gives mechanical designs, dimensions and selection data on Type 'T' Motors from 3/4 to 1000 horsepower for constant and adjustable-speed operation.



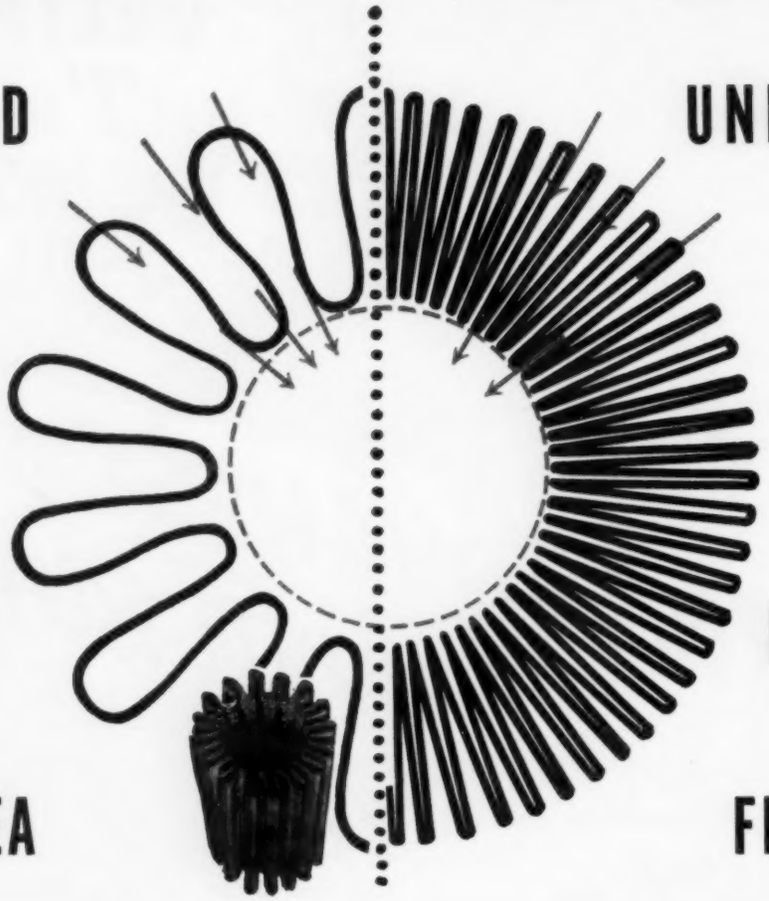
Cross-sectional view of armature with high risers and sturdy spiders indicated.

RELIANCE ELECTRIC AND ENGINEERING CO.

1084 Ivanhoe Road, Cleveland 10, Ohio • *Sales Representatives in Principal Cities*

ACTIVE FILTER AREA vs TOTAL FILTER AREA

BALANCED FOR MAXIMUM ACTIVE FILTER AREA



UNBALANCED BY EXCESSIVE INACTIVE FILTER AREA

LIQUID MUST GET THROUGH TO BE USEFUL!

Elemental, but sometimes forgotten in attempts to pack too much filter mesh into a unit. Liquid entering the outer circumference of the diagrammed corrugated mesh can't be used until it passes out through the inner circumference indicated by the dotted red circle. Marvel engineers have determined scientifically the number of properly proportioned synclinal folds needed to provide the limit of useful ACTIVE mesh area to filter all the liquid that can pass through this outlet space. Crowding more folds of mesh into the same space only increases INACTIVE mesh area; the exit space is the same, can't pass an ounce more a minute. In fact, useless wire mesh obstructing the passage causes even less liquid to pass through. Enough tightly packed folds of excess mesh could cut the flow to a trickle. Balance between mesh openings area and outlet area is imperative for maximum flow rates at minimum pressure loss.

Sump Type (Cutaway)

Line Type (Cutaway)

STORAGE CAPACITY FOR FILTERED OUT MATERIAL

Folds of mesh crowded so closely together that they almost touch do not allow enough space between them for accumulated foreign matter. A moderate amount of filtered out material soon fills up all space between folds and reduces operation to filtering at the outer ends only. Well spaced, properly balanced MARVEL SYNCLINAL corrugations leave plenty of space for foreign matter storage without flow interference or pressure build up. Obviously, a filter lacking such space for accumulated material will require more frequent attention.

FOR ALL HYDRAULIC AND LOW PRESSURE SYSTEMS wherein non-corrosive liquids are filtered. Available in capacities of 5 to 100 g.p.m. and in mesh sizes from 30 to 200. Multiple installation permits greater capacities. Simplify your preventive maintenance with Marvel Synclinal Filters.

CHOICE OF OVER 240* ORIGINAL EQUIPMENT MANUFACTURERS

*As of August 1, 1951.

For complete engineering data on both sump and line type filters Write for Folder 105.

Meets J. I. C. Standards

MARVEL ENGINEERING COMPANY
625 W. Jackson Blvd. Chicago 6, Ill.

Eleven 250 Ton Open Hearths for J&L by LOFTUS

These six Open Hearths shown above are nearing completion and are scheduled to go into production this year. The other five will be completed early in 1952.

Open Hearth crews in leading steel plants throughout the country are establishing shop records with Loftus Open Hearths.

We have records in our files showing Loftus designed and constructed Open Hearths are giving

LOWER FUEL CONSUMPTION
MORE TONS PER HOUR
MORE TONS PER MONTH

That's why we say "Loftus Builds 'Em Better".

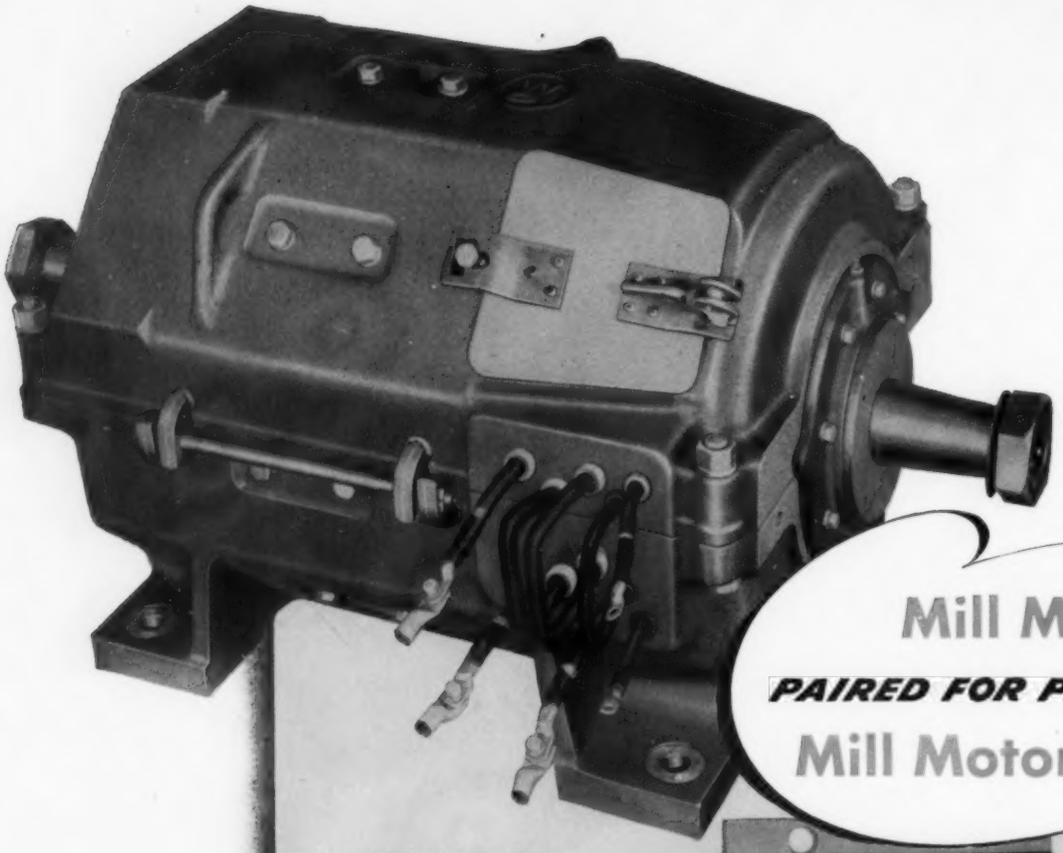
Turn Your Scrap In, Help Turn More Steel OUT!

FROM FIRST HEAT TO HEAT TREAT, LOFTUS BUILDS 'EM BETTER

LOFTUS ENGINEERING *Corporation*

610 SMITHFIELD ST. PITTSBURGH, PA.

Designers and Builders of INDUSTRIAL FURNACES

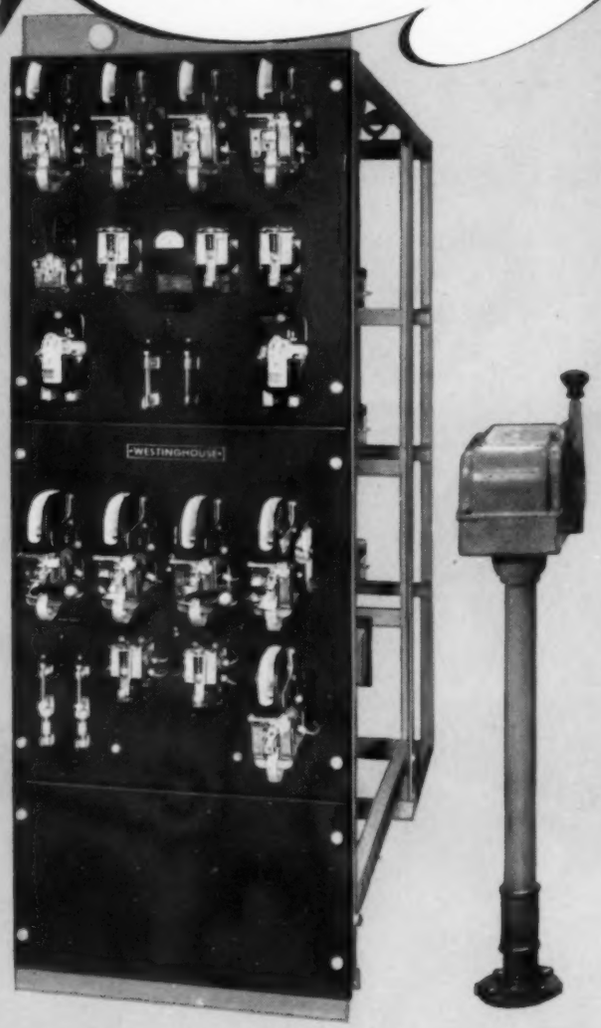


Mill Motor

PAIRED FOR PRODUCTION

Mill Motor Control

600 Series Mill Motor



Typical 9500
Line Controller, Type M
Contactors and Type SM
Master Switch

Rugged!

cut mill down time with this team

Certainly in a mill, where down time costs add up fast, the ability of equipment to stand up to rugged continuous duty is of paramount importance. That's why you'll find this combination hard to beat. They are rugged . . . made together to work together. Each incorporates the latest design features to keep production lines rolling.

Take the motor for example. The high starting torque of this new 600 series mill motor is ideal for high inertia loads . . . proved commutation . . . high rated efficiency assures maximum performance under tough service conditions . . . simplified construction makes servicing and maintenance easy. It is a brand-new motor with a new kind of performance built for today's tougher jobs.

Controllers, too, are built to assure new dependability. Main contactors are the new Type M with knife-edge, trouble-free bearings . . . with exclusive Quick-Quench arc boxes which greatly increase contact life. Overload relays are the dual thermal instantaneous type. Accelerating relays are the time-proved inductive time delay Type AZ.

The third part of this control team is the rugged Type SM master switch. Easy to operate, yet with a definite "feel" for each operating point of position, the switches are available with 2 to 6 speed control.

Together, these three offer a new kind of dependability. Get the facts on all three. Ask your nearby Westinghouse representative for a copy of the new booklet B-4730, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-21647

YOU CAN BE SURE.. IF IT'S

Westinghouse

MILL MOTORS AND CONTROLS

HERE'S WHY

no other coupling costs as little to use as *FAST'S*

With Fast's Couplings you get the lowest coupling cost per year that modern engineering can provide—*because Fast's normally outlast the equipment they connect.* That means their cost can be spread out over 20 years or more!

As two users recently said:

"We've had this Fast's Coupling since 1930 . . . and it's apparently going to last forever. [*Wish*] *the other equipment caused as little trouble!" . . . "We have two Fast's Couplings . . . they are the only equipment so trouble-free we long ago forgot we had them!"*

If you want lower costs, freedom from coupling shutdowns and dependable coupling engineering—specify Fast's. For complete details, mail the coupon for Fast's free catalog. Do it today!

RUGGED CONSTRUCTION:

Fast's still maintains its original design, without basic change or sacrifice in size or material. This assures you freedom from needless and expensive coupling failures.

FOOLPROOF DESIGN:

Instead of perishable oil seals, Fast's Couplings use a permanent metal-to-metal closure to keep dust out and oil in. Oil is always maintained at a safe level whether the Fast's is running or standing still.

FREE SERVICE:

When you specify Fast's Couplings you get Koppers' valuable free coupling service. If your application seems to need a special coupling, Koppers' engineers in many cases can easily modify a standard Fast's Coupling, and save you money!

MAIL COUPON TODAY FOR FREE CATALOG!

KOPPERS CO., INC., *Fast's Coupling Dept.,*
310 Scott St., Baltimore 3, Md.

Gentlemen: Send me Fast's Catalog which gives detailed descriptions, engineering drawings, capacity tables and photographs.

Name.....

Company.....

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City.....Zone.....State.....

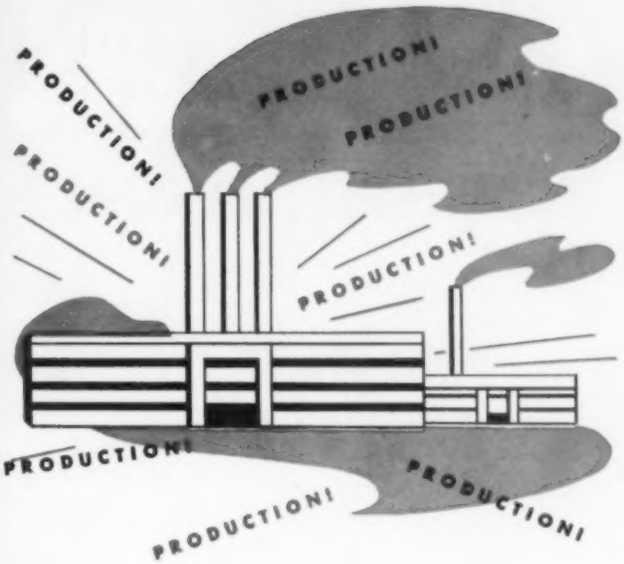
KOPPERS

FAST'S

THE ORIGINAL GEAR-TYPE

Couplings

INDUSTRY'S STANDARD FOR 31 YEARS



SLUDGE!

LEADOLENE

RECORDS SHOW *NO SLUDGING IN FIFTEEN YEARS* WITH

BROOKS LEADOLENE

Sludging—that's the quick, easy way to give any mill man gray hairs. And at the first sign of sludging, take a look at your pinions and gears. You'll see signs of pitting, cutting and excess wear. At this point you will need the skill and experience of the Brooks engineer. He will show you how "LEADOLENE", with its "Indestructible pH-ilm" will stop this excessive wear, pitting and sludging. As a matter of fact, in many instances you can continue using these damaged gears and pinions for years without replacing.

"LEADOLENE" always stays neutral—never becomes acid. Being unaffected by water, wear or sludging—make-up costs are negligible. Keep your mill at top production—change to "LEADOLENE" NOW!

The Brooks Oil Co.

Pittsburgh 12, Pennsylvania
Cleveland, Ohio
Hamilton, Ontario

Warehouses: In Principal Industrial Cities

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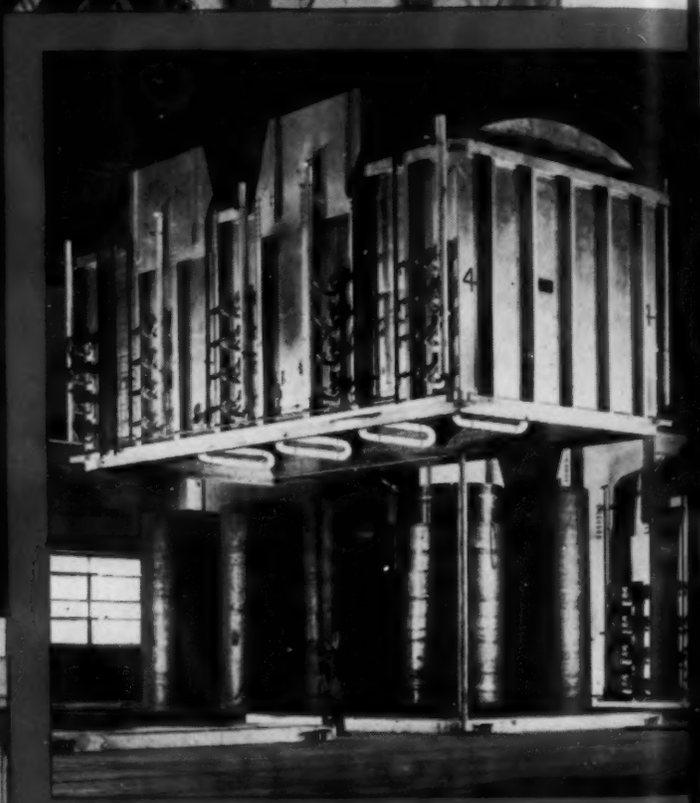

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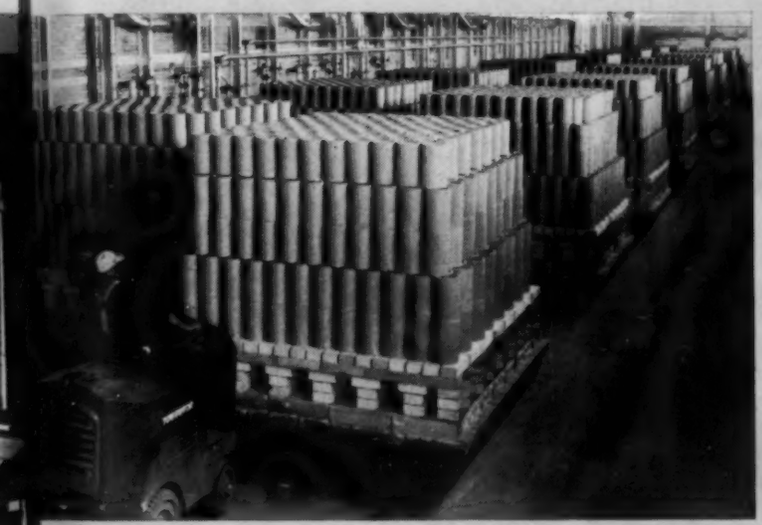

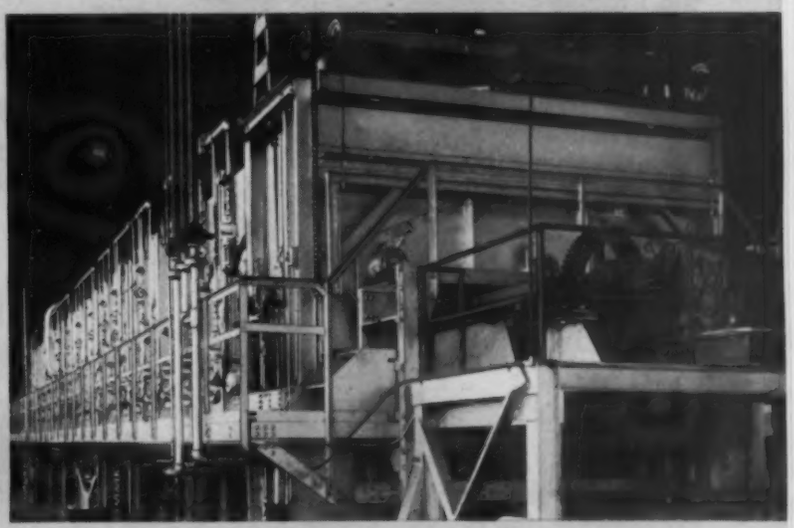

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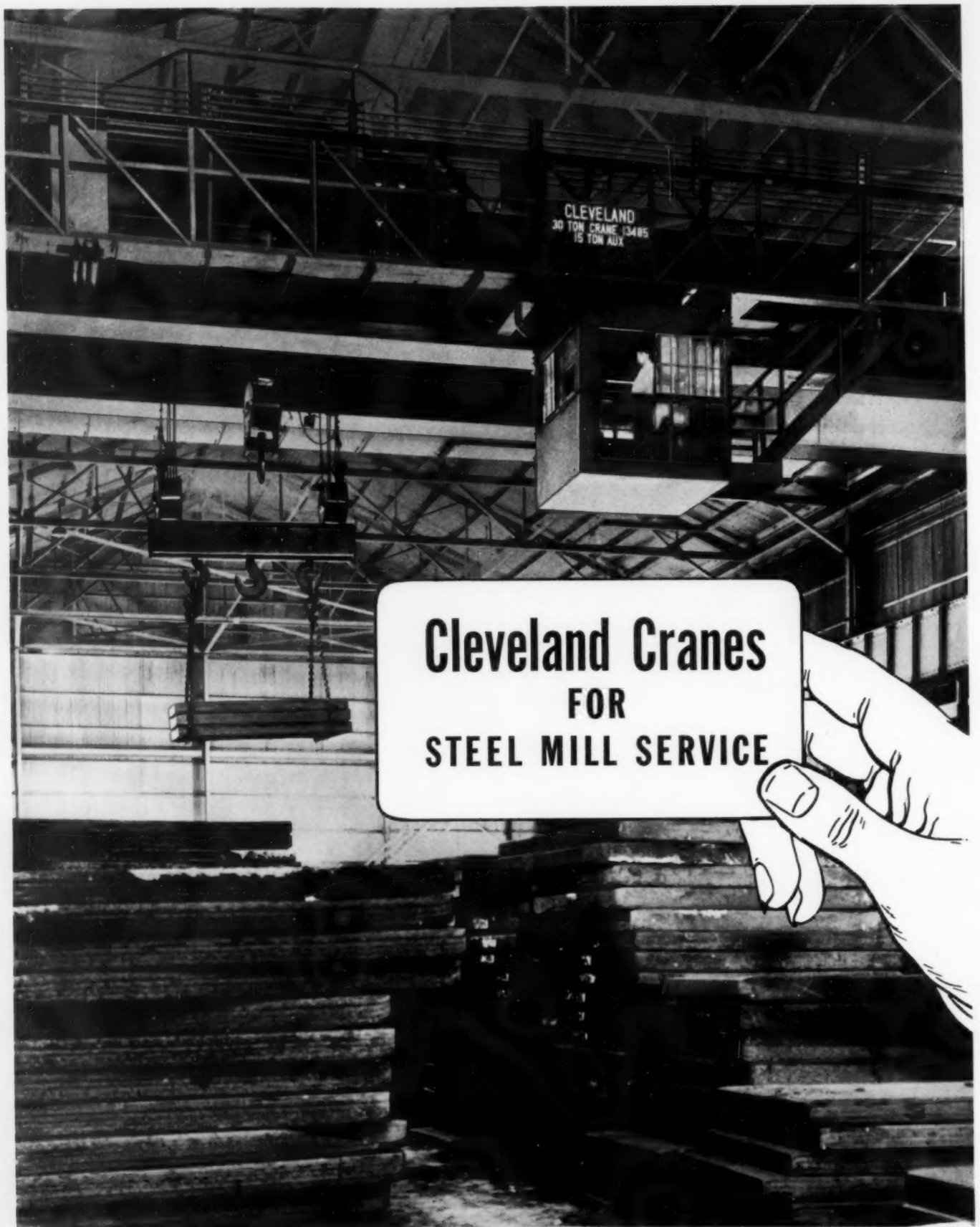

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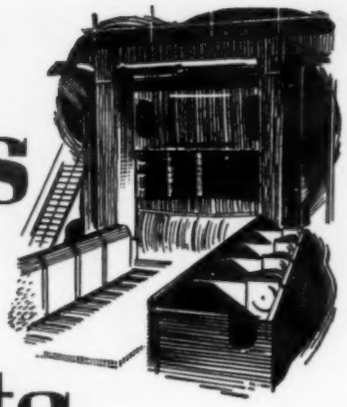

FOR the first time in eleven years the AISE annual convention returned to Chicago, and the attendance of almost 2400 indicates the popularity of the choice. Attendance at technical sessions was unusually good and the formal dinner and dance, with almost 1000 present, set a new high for Association affairs of this type. The Hotel Sherman, with its program of redecoration and refurnishing almost completed, handled the various affairs smoothly, with excellent cooperation and a minimum number of complaints. It was nice to be back in Chicago.

▲

AN interesting sidelight at the Convention was the reminiscing of Wilfred Sykes and James Farrington about the early days of Association history. The strength and prestige of AISE today is a fine tribute to the efforts of these and other pioneer members. Looking over the crowd at the dinner, Mr. Sykes said he couldn't tell whether the present men were better engineers than those of the early days, but they certainly were good pickers.

▲

SO far, scrap collection efforts have emphasized the scrapping of obsolete or near-obsolete industrial equipment, and rightly so, as there is a tremendous potential of material there. As the situation becomes tighter, however, it is time to look to homes and farms. Here is another source for a large amount of scrap but this material is so scattered that it is scarcely economical to gather it up. Perhaps the solution is to enlist the aid of churches, hospitals and charitable institutions as collection agencies, and drive to get every householder to bring his old tools, worn-our mower and other odds and ends of scrap metal to places designated by the various agencies. We'll bet there's a million tons of scrap in them thar homes.

▲

GOVERNMENT agricultural scientists report that, merely by flipping a switch and turning on electric lights, the growth and bloom of chrysanthemums, onions, etc. is speeded up, goats are made to give more milk and sheep are encouraged to breed for a longer time.

And we thought the only crop that thrived in bright lights were wild oats.

▲

MODERN inventions — they're wonderful. The extent of the changes in industrial conditions is emphasized by the following excerpt, sent in by a reader, from a letter from Europe: " . . . we were told that it is necessary to have an air conditioning plant installed at the control stands of the rolling mills and also for the cabins of the cranes running in the halls of the mill, the reason being that working at these spots has become impossible. Up to now the attendance personnel helped themselves by taking large quantities of cold fresh beer; this, however, gave rise to disturbances and the management had to prohibit this taking of beer."

This is an improvement?

▲

AT a recent meeting three consecutive speakers from various departments of the Federal administration emphasized that they were not socialists, nor were they trying to put across a socialistic program. Wasn't it Shakespeare who said "The lady doth protest too much, methinks"?

▲

THE Russian representative at United Nations who insisted that the United States should carry half of the U. N. expense because we are so well-fixed economically had better check before he goes home. Hasn't he heard the dire predictions of Russian economists about decadent capitalistic systems?

▲

THE papers have been full of pleas for blood donors, even to the point of drafting healthy specimens for blood-letting. Certainly, adequate supplies of whole blood and plasma are essential, and should be kept up by voluntary public participation. One government spokesman has attributed public apathy to the fact that the people "have not been sold the idea that we are in a shooting war." On this basis, if things proceed according to plan, we can probably expect rationing of gasoline, shoes or what-not to "sell" us.

Actually, what is needed to make people realize the gravity of the situation is some evidence that the administration itself is taking things seriously, some show of elimination or postponement of non-essential projects, some reduction in non-military personnel and spending — in short, some tightening of the federal belt as the public is expected to tighten theirs. "Politics as usual" can produce only "business as usual."

▲

LABOR unions are beginning to think in terms of "wages after taxes," and want the Labor Department to start taking taxes into account when they calculate the cost of living index. We can think of a lot of things wrong with this idea, but one advantage might be a resultant ceiling on taxes.

▲

THE National Art Foundation says that it is apparently going to be necessary for industry and government to support artistic enterprise, inasmuch as private patronage is waning. This same trend has already been encountered in medical research, which formerly was financed through large private grants but more recently has carried its appeals to the general public. All of this is attributable to the tremendous tax load which has greatly reduced the proportion of large fortunes and the possibilities of accumulating them. If government is to take over such projects, it's going to take a lot more excises to keep Uncle Sam fiscally fit.

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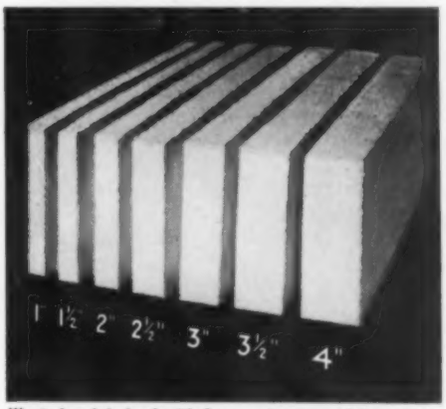

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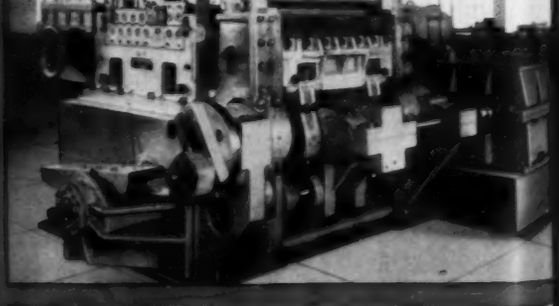

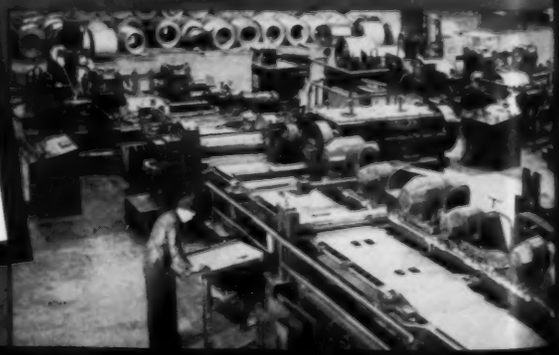

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WHEN YOU MELT... MOORE RAPID *Lectromelt*

The Bethlehem Loop Course

By H. C. HOUGHTON
Assistant to Manager of Personnel
Bethlehem Steel Co.
Bethlehem, Pa.

. . . . the loop course takes in college graduates only, and has been remarkably successful in producing top management personnel . . . .

▲ IN preface to a discussion of any industrial training program it is necessary first to present a basic review of the type of business and organization involved, in order to give a clear idea of the problems with which it must deal. Bethlehem is a fully integrated steel company. It mines coal, iron ore and limestone; produces iron and steel and manufactures iron and steel products, varying from castings and forgings to bridges, buildings, ships, nails, wire and a wide variety of other finished and semi-finished products for use by many other companies. The total number of people employed in this enterprise today is about 130,000, made up of many types and grades of skill and ability ranging from common labor to the most advanced scientific and managerial talents.

Necessarily, college and university graduates figure increasingly in the present and future organization of the company in all its activities.

ORGANIZATION

The organization of the company is very clear cut. Each of Bethlehem's various activities is under the direction of a vice president. For example, the vice president in charge of the steel division directs activities in the steel plants and fabricating works. Likewise, the vice president in charge of the mining division directs mining and quarrying activities. Other vice presidents include those in charge of shipbuilding, sales, purchasing, industrial and public relations, finance and legal affairs, accounting, and traffic.

The operating vice presidents assign responsibility for operations to general managers. As an example, the general manager of a steel plant is solely responsible for the plant's operation, including any training procedures, and reports to the vice president in charge of the steel division. Responsibility in shipyards and mines is similarly fixed, under the respective operating vice presidents in charge.

The training function in the general organization is under the direction of the manager of personnel who reports to the vice president in charge of industrial and public relations. Matters concerning training which come from the office of the vice president in charge of industrial and public relations reach the various plants, shipyards, and mines through the respective vice president in charge of those operations. Thus it is seen that the relationship between the plants and the industrial and public relations department, which includes the training phase of our personnel work, is a functional one.

With the exception of the loop course, which is our college graduate training program and the subject of this paper, hiring of employees for regular work or for our various training programs is done by, and at, the various departments and operations. In the case of the loop course, however, the personnel division at the central office hires loopers after consultation with, and approval by, the heads of the various Bethlehem activities concerned. After their initial training at Bethlehem loopers receive final training at the plant or division to which they have been assigned.

HISTORY OF THE COURSE

In the Bethlehem organization, the practice of hiring college graduates had its start around 1900 when the company employed, among others, Mr. E. G. Grace, now chairman of the corporation, who had just been graduated from Lehigh University with a degree in electrical engineering. The acceptance of college graduates in the steel industry at that time was far different from what it is today. They were rarely wanted in any capacity. There was no real application of science to production such as we find it today, and the old steelmakers jealously guarded secrets in methods and procedures known to them. They generally resented men with scientific training whom they looked upon as intruders wanting to change steelmaking from an art to a science.

The actual origin of an organized loop course program probably came about as a result of the practice of the sales department each year to employ a small group of college graduates for training in sales work. Future

salesmen worked in one of the plants for an indefinite period and were later transferred to sales work.

At this state of development in our training activities, the industry had awakened to the necessity of using advanced technical and other skills in developing and supplying steel products for new markets and ever-expanding uses. In fact, the company was constantly taking on college graduates who possessed knowledge and skills to fill these needs, both in the production departments and elsewhere.

PROBATIONARY OBSERVATION CIRCUIT

The first organized class of college graduates reported in June, 1922, under the loop course plan then known as the "Probationary Observation Circuit."

Recruiting at that time was accomplished by sending to the different colleges application blanks to be filled out by seniors interested in employment with Bethlehem. The completed applications were submitted to the company and selections were made purely on the paper record of the candidates. There was no personal interview prior to enrollment.

At that time, the course was run on the basis that at the end of an initial ten-weeks observation course at the steel plant at Bethlehem, Pa., which was considered to be a typical example of a well-rounded operation, the company and the individual each decided whether or not their mutual interest justified employment. There was no assurance by the company that the graduate was entering a permanent career. Nor had the graduate made a definite commitment. It was nothing but employment on an observational or probationary basis. At the end of the ten-weeks course those who remained in the company's employ were transferred to various divisions and operations as they are today. In the ten-weeks period of general steel company orientation, each day began with a talk by some company official or a plant manager, and this is still the custom. The balance of the day then, as now, was spent on a conducted-tour basis in the various departments of the Bethlehem plant. However, no tightly fixed schedule of plant department visits such as is now in effect was rigidly applied, but instead the loopers were pretty much on their own within each department, from coke ovens to machine shops.

Each year, from 1922 through 1930, a group, varied according to plant needs, was brought into the company by way of this "Probationary Observation Circuit"; and, as years went by, experience was gradually gained in training methods and many improvements were made.

From 1930 to 1934 economic conditions would not permit the addition of a group of college graduates when all industrial activities were down and our operations were at a very low ebb. Likewise, no course was conducted during the World War II years, 1943 through 1946, for obvious reasons. College graduate training was re-instituted, however, in the years 1934 and 1947, respectively.

THE LOOP COURSE

In the early years, when the sales department groups worked and studied in the plant and when later groups of the "Probationary Observation Circuit" went through the plants, the men taking the course became known as "loopers" because they "looped" through the various departments. It was logical, therefore, that the name of the course should be officially changed to "The Loop Course." That change was made in 1937 and continues to this time. One big difference between the probationary circuit course and the loop course was that under the loop program each man is given assurance of permanent employment if he applies himself—the uncertain, probationary aspect was eliminated; and still is today.

Starting in 1934, the company established the practice of visiting colleges to interview qualified graduating seniors, and it has been my duty to handle this interesting job during the last four years.

From 1934 through 1936, inclusive, the first phase of the course comprised several talks by some of the company executives and a short tour of the Bethlehem plant. This brief general orientation covered a period of only three or four days.

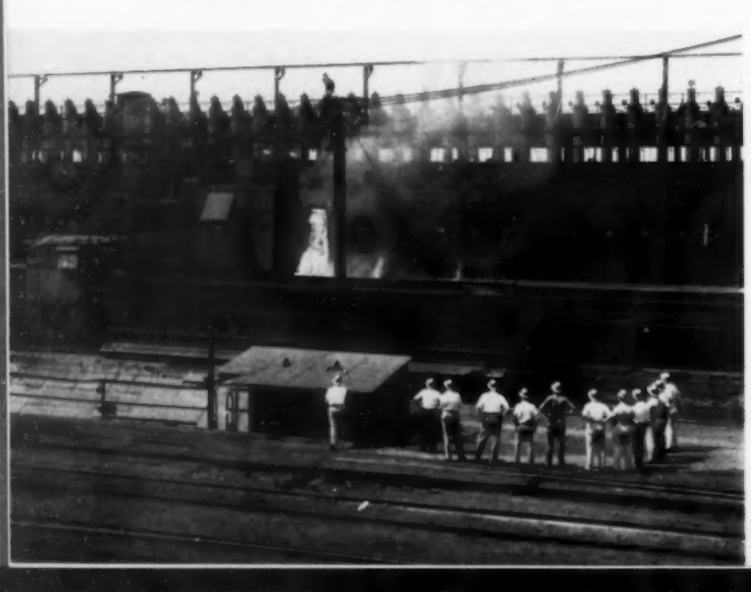
In 1937, the present scheme of conducting the first phase of loop course training for a period of five weeks was instituted. During this general orientation period, a series of talks by about twenty-five officials of the company are conducted, and scheduled orientation in the departments of the Bethlehem plant is given.

OPERATION OF THE COURSE

The question as to whether a loop course will be conducted in any year is a matter of executive determination. That decision is made during the last half of the year preceding the year in which the course is to be held. For example, the decision of the executive group to hold the 1950 course was made toward the end of 1949. It should be explained here that as used within the Bethlehem organization the term "executive" applies to the top men in the company, which include the chairman, president and the ten vice presidents. Each of them closely follows loop course work, which accounts in a very large measure for its established place in our personnel policy.

As soon as it has been decided to conduct a course,

Figure 1 — Loopers are taken on trips through the various departments of the steel plant.



plans are made for the training to be given, and the various divisions and operations of the company are surveyed as to their college graduate requirements. Each determines its needs, and the job of the personnel division is to recruit from the graduating seniors of the current year in which the course is held, the men needed to fulfill the requirements.

After the personnel division knows how many graduates are required, classified by college degrees, arrangements are made with the various colleges for dates when campus interviews may be held. It might be of interest to know that from December, 1949, to May, 1950, forty-seven colleges in the eastern United States and twenty-five on the West Coast were visited. Some 1200 men were interviewed in the East this year for our 1950 course, which began on July 10.

Each year, prior to the start of our college visits, we send to the placement officers, or other proper persons at the colleges, sufficient copies of the loop course booklet and application forms, and they in turn distribute that material to those seniors who might be interested in a career with Bethlehem. Completed applications from the colleges are in due course returned to Bethlehem where a review is made of the submitted applications, in the light of the requirements we have to fill. From the applications, a selection is made of the students from each college who seem to most closely meet our requirements and who, on arrangement with the college placement people, are to be allowed sufficient time for interview at the colleges.

Following the interview, the personnel division consults with the interested people at the home office concerning those he has interviewed. His recommendations, which take into consideration scholarship, extra-curricular activities, personality, work experience, and other indications of the applicants' qualifications, together with the final wishes of the heads of the various departments concerned, determine who will be invited to enter the course. Subsequently, offers are made to those so selected. Normally, we start to send out job offers in February for the course which starts in July and the roster is complete by May.

STATISTICS AS TO THE 1950 LOOP COURSE

As an example of the makeup of the loop course group, the 1950 enrollment, or 22nd loop course, will serve as an illustration. The 1950 loop course group is composed of 104 graduates, mainly technical, representing 41 colleges and universities located in 20 states extending from Maine to California. Most of these graduates are from institutions in the East, with representatives, however, from the Far West, Middle West and South. Seven have advanced degrees; the remainder have Bachelor's degrees. All have taken part in some extra-curricular activities. Twenty-eight were active in varsity competition. A large number have been honored for special college attainments. All but twenty-four are veterans. Thirty-eight were married and sixty-six were single at the start of the course this year. It should be pointed out that the loop course group each year is made up only of graduates of the year in which the course is conducted.

The 1950 loopers have now taken their place in the Bethlehem organization; and have been distributed among the various divisions of the company in the following manner:

81 to the steel division, including steel plants, fabricated steel construction, and research and patents.
16 to sales, including 1 to commercial research.
3 to mining.
1 to shipbuilding.
1 to traffic.
2 to industrial and public relations.

OUTLINE OF THE COURSE

Broadly speaking, the loop course is divided into three parts, or phases, as follows:

1. Basic training at Bethlehem, Pa., for all loopers.
2. Specialized training in the particular field in which the looper is to remain engaged.
3. Actual training "on the job."

Each of those three phases of the loop course will now be briefly described, the first of which is the basic, five-week training period at the company's headquarters, supplemented by daily visits at the company's Bethlehem plant.

One purpose of the basic phase of training is to acquaint loopers with the broad Bethlehem organization and to have explained, by the people who run them, the various activities of the organization. We want the loopers to know in a general way the different activities of the organization, how the control of those activities is designed to create a working team, how each activity is carried out independently but interlocked with the rest to create a smooth-working organization. Each weekday morning the group is addressed by one of the heads of the respective Bethlehem activities as to the functioning of the activity in his charge. The speakers include the various vice presidents, the steel plant managers, and the heads of divisions and of the subsidiary manufacturing companies. Mr. Grace and Mr. Homer, the latter of whom is president of the company, usually address the group informally.

Also, in the basic training at Bethlehem, the group is given a thorough grounding in the operations of a steel plant. We are particularly fortunate to be able to use

Figure 2 — In the inspection trips, the loopers have an opportunity to determine whether they are interested in the work.

the Bethlehem plant, right in our headquarters city, in this observational training, for in addition to typical steelmaking operations, the plant has a number of manufacturing operations, forges, foundries, machine shops and other activities not common to all steel plants. In fact, there is really a grouping of thirty-one industries within the plant's confines.

By use of movies made by the company, we endeavor to show the relationship of all these divisions in the steel plant very early in the course. A quick trip by train through the plant also provides an opportunity for on-the-spot coordination of the activities in the loopers' minds before they enter the schedule of planned departmental visits.

It may interest you to know that this year we made use of a list of texts and references prepared by the Association of Iron and Steel Engineers in answering the many questions that arise among these young engineers as to sources of information. This list has been published as "The AISE Bookshelf," Proceedings of Association of Iron and Steel Engineers, pp 828—829.

Before leaving the early phase of the course, it is well to point out that a "clambake" and some other more or less spontaneous affairs tend to relieve the purely "work and learn" approach and provide opportunity for establishing mutually satisfactory and lasting friendships.

At the end of the five-week period, the second phase of training begins.

At this point it should be stated that loopers are selected, even in advance of their employment, to enter a particular activity; and it is with this second phase of the course that they are separated into the various divisions where they are to remain. For example, those who have been selected to enter steel plant work within the steel division are assigned to one of the steel plants; those selected for the sales department will enter into sales work; those selected to enter coal mining in the mining division will go into coal mining work; and so on. The assignment of an individual looper at the end of the five-week, basic period is limited to the activity or type of work for which he was engaged, unless during the five-week period an opportunity has arisen which causes his assignment to change, or it has become evident that he might obviously be better qualified for some other type of work, and an opportunity is present for his assignment to another division. Prior to the start of the second phase of training, then, loopers are assigned to particular divisions of the company, recognizing their wishes and qualifications and the needs of the organization.

Those going into steel plant work are assigned to a particular steel plant, and after orientation in that plant, each is assigned to a specific department within the plant.

Those assigned to the fabricated steel construction department of the steel division receive training in engineering, fabrication, and erection of steel.

Those going into the sales division are given a basic training in sales work, which lasts about a year before assignment to actual work in a sales department. That training for a salesman includes observation and explanation in each of the seventeen product divisions at the home office, with visits to the plants producing the various products. Then the future salesman is assigned to a specific sales activity.

Loopers assigned to shipbuilding receive basic training at the shipyard where they will later be working.

Those assigned to mining are given further training and final assignment in coal mines or other operations.

Those assigned to the other home office departments such as industrial and public relations, treasury, traffic or research, enter directly into those departments for training. All of that training in specific divisions to which the loopers have been respectively assigned represents the second phase of our loop course.

The third phase of the loop course is regular work on the job. That phase, of course, is the most important, as the individual actually assumes responsibilities, and it is through such responsibilities that growth is attained. The general and specialized training covered in the first and second phases of the course are tools with which the loopers have to work, the foundation, so to speak, upon which they are to build. It is in the actual performance of the job during the third phase of the course that the looper demonstrates his ability to deal with the many factors which make for success.

Figure 3 — The Bethlehem Plant of the Bethlehem Steel Co. provides an opportunity to observe many different types of work.

PERIODIC PROGRESS REPORTS

The progress of each looper who has completed the course is recorded quarterly in an informal way for the first two years, and the progress of loopers is thereafter recorded yearly by a report submitted to the vice president in charge of the activity in which the looper is engaged. The annual report is made as of October 1 of each year. That means that once a looper, the individual is always a looper.

Reports are readily available covering each person who has entered the course since its inauguration in 1922. Many of the loopers have attained high positions, as, for example, general traffic manager, general manager of a steel plant, head of ship repair sales, assistant to vice president, assistant general manager of sales, manager of sales, manager of industrial relations, and assistant general manager of certain plants, to name a few. Since the start of the loop course, over 1700 men have entered the employ of the company in this way.

DISCUSSION

PRESENTED BY

PAUL E. THOMAS, Assistant to General Supt., United States Steel Co., Gary, Ind.

H. C. HOUGHTON, Assistant to Manager of Personnel, Bethlehem Steel Co., Bethlehem, Pa.

F. H. CASSELL, Supervisor Industrial Relations, Inland Steel Co., Indiana Harbor, Ind.

K. A. MOODY, Training Director, American Steel & Wire, Co., Cleveland, Ohio.

WILLIAM WHIGHAM, JR., Assistant Vice Pres. Industrial Relations, Carnegie-Illinois Steel Corp., Pittsburgh, Pa.

V. E. SCHLOSSBERG, Assistant Chief Engineer, Inland Steel Co., East Chicago, Ind.

J. S. KOPAS, Training Counselor, Republic Steel Corp., Cleveland, Ohio.

E. W. KEMPTON, Assistant Vice President, United States Steel Corp. of Delaware, Pittsburgh, Pa.

Paul E. Thomas: I am sure we all agree that many troubles that are experienced with top management can be directly traced to the lack of planning in our original selection of supervisors, and many of our problems can be traced to the lack of attention and lack of planning for many who originally showed promise, and yet, who fell by the wayside. They were men who would have become good men, but they did not receive any planned training; they were men who were checked "all right," but who were forgotten once they were made supervisors.

In your loop course, do you ever provide for the entrance for training of candidates who are rank and file employees; men who have no college degrees, but men who have come up the hard way? If you do not permit them, how are they trained? As I understand your course you recruit college men and then after putting them through this special type of course, they come out as managers. At your local plants, is there a means by which men can come up through the ranks, who are training to go into supervision?

H. C. Houghton: We have no regular organized program which takes in rank and file employees. I have to point out every year when I go to the colleges the answer to that question. There is not only one way to go to work for the Bethlehem Steel Co. We hire many college graduates who change their minds. They say that they are not interested in the company but, by the time they are ready to graduate, decide to work for Bethlehem. We get four to five times as many college graduates into the company as we get through the "Loop Course." Of course, that was always the way to get anywhere in a large organization anyhow, go to work, get started—the plant personnel and work will develop you.

F. H. Cassell: I noticed the preponderance of engineering graduates selected for the "Loop Course." What about balancing such a situation. That is, I recognize that engineers have an important place in the steel plant, but there must also be a place for men who are not engineering graduates; for example, it is not unusual for us to have a man become a supervisor who is not an engineering graduate. We have a man who is a top-flight supervisor who is a graduate in forestry.

I wonder also how much consideration has been given to the fact that the usual engineering curriculum does very little to prepare the engineer for the handling of human relations.

H. C. Houghton: This also is one of the questions which comes up every year. Naturally, the colleges know perfectly well that we have places for business administration graduates, liberal arts graduates, and others.

I would refer to one remark which I made in the paper which was that we recruit a group of "Loopers" based on requirements transmitted to us by the plants. We do not put "Loopers" into a division of the company which does not want "Loopers."

If you noticed the distribution, as I read it in my paper, I said that 81 went to the steel plant. I said that 1 went into shipbuilding, 3 went into mining and 1 had gone into research. Those were all asked for. We try at first, as nearly as possible, to fill the requirements which the plant sets up. If they ask for 8 mechanical engineers, I am going to need to be a terrific salesman if I can sell them a Ph.D. in Philosophy, or a Masters Degree in English or History, all of whom are coming to us for jobs. I say to those liberal arts graduates, business administration graduates, and others, the same thing I said in answer to the other inquiries—go out and go to work in a plant. If we put you in this program, when a superintendent or plant manager asks for an electrical engineer, and you have the best Ph.D. in Forestry or Philosophy, or anything similar, you are handicapped. Go out and go to work! That is always my answer to these arts and business graduates. We are exposing you to an opportunity to use the college graduate's bag of tools as a guide. Go to work in a plant. We have had splendid results from many of these graduates, not due to training on an organized basis the way the "Loopers" are, but who, due to personal efforts, have worked out satisfactorily. So far as balance is concerned, we do not try to legislate it but find that the personnel maintains balance predicated on the needs of the plant that produces steel.

K. A. Moody: It is interesting to me that the fundamental statements and background which Mr. Houghton presents in his description of that course, would be so ably substantiated by our own experiences extending over the years. Now that does not mean that since we necessarily agree, we must be right, but it is interesting that two companies who work in the same field for a long time should come to so many fundamental basic viewpoints on which they agree.

The ones that seem of particular interest to me are these: First of all, it is not true in industrial organizations that all training must start at the top. I hear that a lot, but it is a very limited statement. In dealing with the problem of selecting and training college recruits, however, it is especially important that you do have the support of the top and middle levels of management. In this problem you have compulsions of the long-run personnel needs of the organization, balanced against the short run compulsions of costs, and unless you get strong support at the top echelons, you know which compulsion is going to win, and so do I.

Secondly, I would like to point out that there is an

optimum number of college graduates which any given organization can absorb within any given period of time. If you bring in too many at one time, you clog the channels of promotion for them, and for the non-college people, so a lot of good men are either lost or needlessly retarded. If you bring in too few, there is a gradual diminution of the talent available for replacement, and in the long run, the weakening of the organization is just as sure as death and taxes.

The third point I would like to remark on for a moment is that of the problem you have with the college recruits of "specialization vs. generalization." If you keep the course too generalized and the recent graduate wanders around for a long period of time, he will lose much of his pep and enthusiasm. In addition, the course will be discredited in the minds of the supervisors, especially of the lower level supervisors. They will wonder how the company can afford to keep so many people wandering around "doing nothing," while the supervisors are always being held to strict accountability for their costs. On the other hand, if you put the graduate too soon on a narrow routine job too close to his immediate capabilities, his vision is obstructed. He can not see the forest for the trees, and he becomes discouraged and disheartened.

It seems to me that the "Bethlehem Loop Course" has done a good job of balancing those two things. In the initial period, it gives these fellows the broad vision of the forest, of the opportunities for growth and challenge within the organization, and then, after awhile, it puts them down to work where they are really earning their pay.

The fourth point I would like to make is that I wish that we had those records of twenty-three years of growth and development in a program such as the "Loop Course." They certainly must be marvelous guides for Bethlehem's selection and recruiting and training procedures. I think the development and use of such records is an indispensable part of any similar program, if you are going to get anywhere.

Finally, I want to express my pleasure in listening to Mr. Houghton's paper, because I think he has so ably demonstrated why it is that the "Bethlehem Loop Course" is possibly the best known program for college graduates in the steel industry, and certainly one of the best known in all American industry.

William Whigham, Jr.: A few years ago, things were not done the way things have been done in recent years. I recall quite distinctly that when May or June came along, seniors started thinking about a job. There was no recruiting. Nobody came from any company. Seniors, on their own initiative, had to go out on a trip, contact a company, then go to two or three others, make their selection and see if they passed muster with a company they liked. They were very well pleased when they got a job which paid $60 a month.

We have come a long way since then. As a matter of fact, the Bethlehem course and programs for selection and training of college graduates in many companies show that industry recognizes that technical knowledge is an essential part of many jobs.

In Carnegie-Illinois, we have had experience over the years with the problems of college recruiting. One problem in particular, as Mr. Houghton indicated, has been convincing old timers and others who do not have a college education that they need not regard "loopers" with suspicion, wondering whether the members of the group are going to "take our jobs."

I believe experience indicated generally that there was resistance, and there probably still is, to introduction of the college man, particularly where management jobs are part of any future promotions. Both the college man and the fellow who does not have a college education, however, take the best jobs they can get, and neither has promotion guaranteed him. I do not know what the average company percentage would be between college graduates and non-graduates, but I suspect that non-graduates predominate. You would know these figures for your own company.

There are many good men who do not have a college education, and it would seem that there is need, in management, for better balance between the two groups. If we are to achieve the objective that Mr. Houghton outlined—that is, getting a management team which is coordinated, where each member works with the other members as a team and feels that he actually belongs to management—then there should be greater opportunities for non-graduates to get development or training. For example, in addition to college recruits receiving training in a special group, perhaps some of the men from the ranks should be given that training. As a matter of fact, this point was demonstrated in the Carnegie-Illinois "Management Candidate Program." Plant management said that the program was very good and would benefit our present foremen, too.

Perhaps many of you either have experienced it yourselves, or know people who have been promoted to a foreman job. Some cases run like this, and I have heard many similar stories from present day superintendents about their own experiences. Here is an example. A worker was leaving the plant one day and happened to be walking past the superintendent's office when the superintendent came out. As Joe started to pass, the superintendent said "Joe, what would you think of being a foreman?" Joe said, "I don't know. I don't know if I have everything you want." The superintendent then said, "We have thought of that, and starting tomorrow you go over to see Jim and you will be foreman of Section A." This man was taken back for a moment as you would suspect, and finally said, "Well would you tell me what I should do so that I might do a good job?" The superintendent told him "You just go over and see what the other foremen are doing and do the same—you will get along alright."

I think if you talk to management people, from the foreman up to top levels, you will find many such experiences. I recall one conversation with an executive who said he never had been given any particular advice or definition of the scope of his responsibilities with any of his promotions. He generally was told that the next day or the next week he would have a new job and good luck, go to it. Whether or not this is typical of all promotions, it does emphasize the point.

Important as the induction of technically trained men may be, it is but one part of the total picture of management selection and development. If we are going to have a balanced management, our experience suggests that we should take notice of things we have not done for the non-college men and give consideration to supplementing college graduate training. Our think-

ing has progressed to the point where men from the ranks are being selected to enter the Management Candidate Program each year. They may be college graduates from the previous year who have done well. They may be non-college men who have supplemented their education by going to night school. It is surprising what some have done. Some have gone to night school five to eleven years to get a degree.

We should not overlook the effort of people, who through misfortune or whatever cause, have not been able to get a college education. They deserve an opportunity to have training and development such as the young men from college get as a management candidate. If they have been taken literally by the coat collar and thrown into a foreman job, there is considerable need for them to be developed in their position responsibilities. So whichever way it goes, there is a challenge to improve present and past practices.

This convention is one of engineers, and as has been pointed out this morning, production machinery has made more and more evident the need for highly specialized technical knowledge. Even in operations, supervisors in the plants have need for at least a practical knowledge of the technical side of their jobs. While technical knowledge is essential in many things, however, we cannot afford to stress it to the exclusion of all other factors.

Being an engineer myself, and having had opportunity to observe a number of engineers, I have noticed that engineers generally tend to build a "Chinese Wall" around themselves. Some say we are doing a type of work where we should not be bothered with such things as being able to get up and talk about what we are doing. When told they have a good idea and asked "Why don't you tell the people about it?" the answer frequently is "I can't talk, let somebody else do it, I am not a speechmaker." Many of them have very good ideas to put across, but when asked "Why don't you do it?" they say "I am not a salesman. Let the salesmen do it." That is gradually being broken down, as evidenced by the many sales engineers there are today.

I believe there is a trend in engineering which we cannot escape. That is, there is great need for recognition of the human factor. As Mr. Houghton pointed out in his address, top executives got down to earth and put the human touch to his program by talking to these boys personally. There is no substitute for personal contact as a means of communication. You can take the best steel plant in the world, new equipment, and say we have the most modern design. What can it do by itself? It does nothing except when people run it. The high technical skills that have been required to design modern equipment and facilities may have crowded out the real fundamental, that nothing happens unless people act. Our foremen must know how to deal with people, because they cannot get anything done unless they get the workers to do it. In my humble opinion, the biggest challenge today is—recognition of the human factor, and the intangible things that are needed for people to do their jobs voluntarily—and to want to do the job. It has been proven many times, that people cannot be driven to do things well by force. They may do the job because they are afraid they will lose it or because fear that their families may be in want compels them to accept it.

I do not believe we will get full production any place from men who have fears or resentment. The big job is to get people to want to do their jobs. We cannot mechanize human relations. No formula will make people work together. They must want to do so. What causes strikes, slow downs, bad attitude and everything that retards productivity? That is one of our biggest problems. One author said that foremen and workmen are losing interest in economic education. If they are, then management has failed in this area so far and must intensify its efforts to get every supervisor and employee to realize how important certain basic economic factors are to the nation, business and themselves. It must find better methods of obtaining a common interest in further developing these factors which have made this nation the land of opportunity which it is today.

I think that I have touched upon a few important points, and I would recommend to engineers and others in management that they give most careful attention to the human factor.

V. E. Schlossberg: Speaking of different colleges and which of them are good engineering schools, we believe that many good engineers come from Purdue and we also believe that it is one of the best engineering colleges.

Purdue, during the war, did a great deal of work on training war workers. After the war, in April, 1948, we approached them and asked that they set up in one of their technical centers a "Motor Inspector Training Program."

Our boys at the plant went through their text books and we worked up a two year course, giving such subjects as d-c machinery, a-c machinery, d-c circuits and a-c circuits. The men were asked to enroll in the program and attend voluntarily on their own time. We had a record turn out and our first group consisted of fifty men. Since that date we have had six additional groups.

In June of this year, the first group consisting of twenty-seven men graduated. We had a dinner at which time these men were awarded their diplomas.

Another group was started in September and we have sixty-three people enrolled. We plan to have the same subjects taught twice a day in afternoon and evening sessions, twice a week. This makes it possible for people working shift work to attend every session during the course of the week. If you attend the afternoon session you do not have to attend the evening session.

There is one more point I would like to discuss and that is the problem of supervisors' grievances. We believe a great deal can be done on that if conferences are held monthly, as stated by one of the speakers, but not necessarily at superintendents level. In our electrical, power and steam departments every foreman reports to a general foreman and every general foreman to an assistant superintendent. We happen to have four assistants with whom I work. I try to have a meeting with the assistant superintendents once a week, the same as the assistant superintendents have with the general foremen and the general foremen with the foreman. These meetings are held on a conference basis and is not a meeting where we tell people what to do

but a means of trying to arrive at the best way of doing a job.

J. S. Kopas: One of the biggest problems the steel industry faces today is that of maintaining and improving the quality of its front line of supervision which, in reality, is the front line of management. The quality of the first line of supervision has undoubtedly suffered because the people who have ambition and ability generally do not want to bump up against the terrific odds that seniority puts in their way, so they remove themselves from the competition.

Recently I had a discussion with a young college graduate who said he was very much interested in the operating-management phase of the steel industry but got discouraged after he learned about the difficulty he would have in getting the experience required for effective supervision. He added up the interval of years between the present age and the retirement age of each of the men on the jobs that he would have to do in order to obtain the experience essential for a supervisor, and the total was 240 years. His remark was, "Shucks, that's a long time to wait to get the experience to become a supervisor. If it were 100 years, I wouldn't have minded so, but 240 years is something else." He quit to take a job with a small construction company.

This is a difficult problem. One of the best ways for management to make things difficult for itself is to allow the quality of its candidates for foremen to keep progressively going down. What can the steel industry do about the problem? Bethlehem Steel Corp. has done a remarkable job of trying to overcome the difficulty mentioned by means of the loop program described by Mr. Houghton. Our program at Republic has been greatly aided by the program at Bethlehem Steel and other companies. We have tried to overcome an aspect of supervisory selection and training that can be demoralizing to the workers and make it difficult for our trainees to get full cooperation from the workers on the job after they have become supervisors. Taking young men directly from college who have a superabundance of talent, outstanding personalities and educational records and, after a few years, promoting them to supervision can create resentment on the part of the employees of the department. Seldom are the trainees accepted by the rank and file workers as leaders, which the trainees have to be if they are to be effective supervisors. This method of selecting and training supervisors adds to the difficulties which the trainees face in getting the workers' acceptance and also widens the rift between management and the workers. In our program entitled, "Technical Operating Training" Program, which is quite similar to the "Loop" Program, we feel we have overcome the difficulty mentioned.

We do not recruit people directly from college for the program. We want the training program to be primarily an employee training program. We want and hope that college graduates will seek employment with us because of the opportunities the training program provides them to gain the experience necessary for supervision. The educational requirement for consideration in our program is high school education. Approximately one-third of the trainees in our program are college graduates, a third have had less than two years of college, and a third are high school graduates. The first group of trainees had an average of five years of steel making experience. Because of the way we selected our trainees, their acceptance by their fellow employees was excellent and their success as supervisors has been greatly assisted by this acceptance and by their broad experience.

The uniqueness of our program is the method we used to select qualified candidates for the program. We used vocational guidance technique to select from among our employees the individuals who had the interest, potentiality, and minimum training desirable for supervisory candidates. In order to get a large enough group to select from, we asked each superintendent to pick four times as many candidates as he would have in the program. We felt rather certain that by choosing that many candidates and applying the techniques of vocational analysis, we would be able to pick a sufficient number of candidates who would have the qualifications we were looking for. Experience proved that we were right in making that assumption. As a result of the method of selecting our trainees, we have been able to encourage college graduates to work for us and to earn the right to throw their hats into the ring along with our other employees when succeeding groups of trainees are selected.

A rather interesting by-product of the training program was a request from our foremen that they also be given an opportunity for further training. "These trainees," they said, "are just going to become foremen and you are giving them this valuable training. We are foremen and we did not have it. Why should we not be given similar opportunities?" As a result, an identical program of training, with the exception of the on-the-job part of it, has been made available to our foremen who enroll and participate on a voluntary basis. In some of our plants, nearly 50 per cent of our foremen have participated in the lecture and visitation part of the "Technical Operating Training" Program.

Briefly summarizing our experience, it can be said that vocationally analyzing our personnel provides a feasible approach to the selection of the right type of supervisory trainees and, by utilizing the talent we have within the organization, the program becomes an incentive for additional talent to come into the industry and utilize the opportunity to gain the necessary experience and training essential for supervision.

E. W. Kempton: What is your responsibility in administering steps two and three of your procedure, in relation to the statement of philosophy, that, "Once a Looper, always a Looper?"

H. C. Houghton: The three phases of the Bethlehem program are the five week basic orientation, the orientation in the plant and the "on the job training." The last two steps are pointed out in this question.

The plants and operations submit programs of training for these phases to us for approval. We act only in an advisory capacity. The programs approved vary in length from about three weeks, to twelve weeks, depending to great extent on the size of the plant and the complexity of the operation. For instance, we have a nut and bolt plant at Lebanon, Pa. Within a space of three weeks time, a fellow can get an excellent idea of what that plant is like, what it does and who runs it. This is similar to what is shown him in the five-week program at Bethlehem. During the five weeks we show him what Bethlehem is, who runs it, who are the people in management. At Sparrows Point, our largest steel plant, he

gets a good picture of the same thing in about twelve weeks. That is the second phase. We follow it up, and make comments on the program as submitted by the plant.

In the third phase, we are involved in assisting the plants in properly placing the man on a job. For instance, I have in mind an actual case of an electrical engineering graduate. He was always interested in financial work. He selected electrical engineering to study, but he was always thinking about financial work. He wanted to talk to somebody in the company about getting into a credit or financial job with the company. We helped him in getting the situation handled.

When we say, "Once a Looper, always a Looper," we simply mean that we follow the man's progress. Much of the talent that is in the loop course, like a lot of talent which is in your plant, as well as ours, goes to waste.

E. W. Kempton: Is your advice sought by management, concerning the transfer and promotion of these loopers?

H. C. Houghton: Yes. Very definitely.

E. W. Kempton: Do you have adequate procedures for collecting accurate information?

H. C. Houghton: Yes.

Joseph H. Kopas: We have taken just the opposite position on that problem, Mr. Kempton. We hope that our TOT's finish up the program and become a member of the supervisory team of the department. They are no longer TOT's, they are supervisors. For example, when I go out to follow up on a TOT that is through the program, I make it a point to get the permission of the superintendent to do so, because we do not want to give anyone the impression that one of our trainees, is going to be treated any other way than any other supervisor, once he becomes a supervisor. We feel pretty strongly about that point. We hope that maybe there will be informal grouping of the men, etc. If we are going to ask the advice of our supervisors, we want our TOT's to participate as supervisors, and be a part of the total supervisory picture.

There are real problems involved in bringing people into the organization, as you know, and of keeping morale high, and not getting into some difficulty that might arise in the field of human relations.

The major reason for my follow up of the progress of the TOT's, after they are through, is in terms of improving our procedure of selection, and of getting the data first handed. There is no other reason that I have. As far as the success of our TOT's, or our supervisors are concerned, I think we are equally interested to do what we can in helping, regardless of what channel they come through.

AISE AWARD WON BY LORIG

▲ The Board of Directors at their meeting on September 30th approved prize winning Kelly Award papers for 1950. First prize was given to E. T. Lorig, chief, Senior Staff Engineering Bureau, United States Steel Co., Pittsburgh, Pa., for his paper on "Automatic Self-Centering Rolls and Pulleys." The paper was published in the November 1950 issue of the Iron and Steel Engineer.

Carl G. Hogberg, assistant to chairman, Blast Furnace Committee, United States Steel Corp. of Delaware, Pittsburgh, Pa., won second prize with his paper "Technical Aspects of Northern and Southern Blast Furnace Practice", which was published in the October 1950 Iron and Steel Engineer. Another blast furnace paper took third prize which was awarded to Frank Janecek, former blast furnace engineer of the Republic Steel Corp., for his paper "Five Years of Blast Furnace Operation under Elevated Top Pressure." This paper was published in the January 1950 Iron and Steel Engineer. This is a posthumous award, as Mr. Janecek died in September 1950. There were many other excellent papers published during the year, and it was difficult for the committee to select the outstanding papers. Among the runners-up in the competition was Ross E. Beynon, superintendent, Roll Shop Department, United States Steel Co., South Works, Chicago, Ill., for his paper "Pass Design of Angular Sections," which was published in the June 1950 Iron and Steel Engineer. Other runners-up included C. W. Barrett of Republic Steel Corp. for his paper "Rail Slitting Mill," which was published in the August 1950 Iron and Steel Engineer; and Andrew F. Kritscher of National Tube Co. for his paper "Design and Performance of Large Rotary Furnaces," which was published in the February 1950 issue. Other papers mentioned in the contest were those by T. W. Boulter, Alan D. Brandt, James A. Shea, W. K. Dumbaugh, C. J. F. Burch, William H. Mohler, and Donald L. and James A. Clark.

The Kelly Award carries prizes of $300, $200 and $100 for first, second and third place respectively. The award was established September 28, 1943 to honor John F. Kelly, managing director of the AISE from 1917 to 1934, and to perpetuate the memory of his achievements in the advancement of the Association.

The award is made each year by the board of directors of the AISE upon the recommendations of the editorial and executive committees of the Association.

Rules of the Award:

1. The Award shall be given annually to the author of the paper, adjudged of greatest value in the advancement of engineering or operating practice in the iron and steel industry.
2. The entries for each judging shall be the papers published in the Iron and Steel Engineer during each calendar year, although some may have been presented at meetings in the previous year. Voluntary contributions of papers not presented at meetings but published by the Association are also included in the judging.
3. To be eligible for the Award, the author must be directly employed in the iron and steel producing industry. The author need not be a member of the Association of Iron and Steel Engineers.
4. The award shall be made at the annual fall meeting following the close of the calendar year.
5. The award shall be made by the board of directors of the Association on the recommendation of the executive committee of the Association.

THE AXIAL COMPRESSOR FOR *Blast Furnace Blowing*

By W. O. LOWELL
Allis-Chalmers Manufacturing Co.
Milwaukee, Wis.

. . . . the axial compressor may offer economies over the centrifugal blower for blast furnace service. . . .

▲ FOR blast furnace blowing service, an overall efficiency improvement of 14 to 16 per cent can be realized with an axial compressor over a comparable centrifugal blower in the larger ratings. This can mean annual savings of over $20,000.00 per unit in the cost of steam alone. Although these may seem to be rather sweeping statements, the design of axial compressors together with the performance record they have built up, now furnishes adequate evidence that they deserve serious consideration in any blast furnace installation calling for large volumes of air.

The phrase "There's more air than ore in iron," referring to the approximately 3.5 tons of air supplied to a blast furnace to make each ton of iron, has often been quoted to emphasize the importance of the blower in the blast furnace operation. In addition to high lighting the importance of air in the iron process, this phrase also brings out the necessity of considering air as an important raw material that must be "purchased" as economically as possible. Hence the inherent higher efficiency, the "straight through" air path and the higher rotative speed of the axial compressor, offer definite savings over the centrifugal blower in taking the so-called "free air" and compressing it to a pressure where it can be used in the furnace. While air is "free" it approaches the status of an expensive ingredient, especially when it may cost in the neighborhood of $190,000.00 per year for steam alone to supply air to a large blast furnace.

In considering any new type of equipment for a well established industry, prime consideration has to be given to the reliability and record of performance in other industries and applications. This is especially important in blast furnace service where the blower has a full time job day after day with shut downs only for routine inspection purposes. The axial compressor can ably qualify in this regard since in the experience of the writer's firm alone, there has been fifteen years of design and operating experience involving axial compressors handling a total of over 2,250,000 cfm and using in excess of 250,000 installed horsepower. These units vary in size from 9000 to 860,000 cfm and serve the petroleum refining, aircraft testing, railroad and gas utility fields.

The axial compressor is essentially a large volume machine in that its axial or "straight through" air path can readily be designed for very large volumes by increasing the rotor diameter and blade height sufficiently to provide the proper air velocity through the unit. Casing diameters of axial compressors are much smaller than for a comparable centrifugal blower. In the centrifugal blower, the velocity-pressure conversion is accomplished in a radial direction through the impeller-diffuser combination with a return passage to lead back to the next impeller, whereas, in the axial compressor, alternate rows of moving spindle and stationary cylinder blades accomplish the same function but carry it out in an axial direction. The elimination of this return passage is one of the major factors leading to the higher efficiency of the axial compressor.

Figure 1 shows a cross sectional view of an axial compressor suitable for blast furnace blowing service. The casing is cast iron, split along the horizontal centerline with circular, flanged inlet and discharge openings. Substantial bearing pedestals, with top halves removable, are bolted to the casing. Two pressure lubricated sleeve load bearings and a separate Kingsbury thrust bearing, all spherically seated, are located in these pedestals. The rotor is a hollow steel forging securely bolted to the two forged shaft ends.

The axial compressor blading for a 30 psig blast furnace unit consists of a row of "pre-whirl" vanes fastened to the cylinder at the inlet, followed by approximately eighteen rows of alternate spindle and cylinder blades, comprising nine stages, with additional straightener blades at the discharge. Each blade is of heavy section, either forged and machined or precision cast and is adjustable after installation. With precision cast blades,

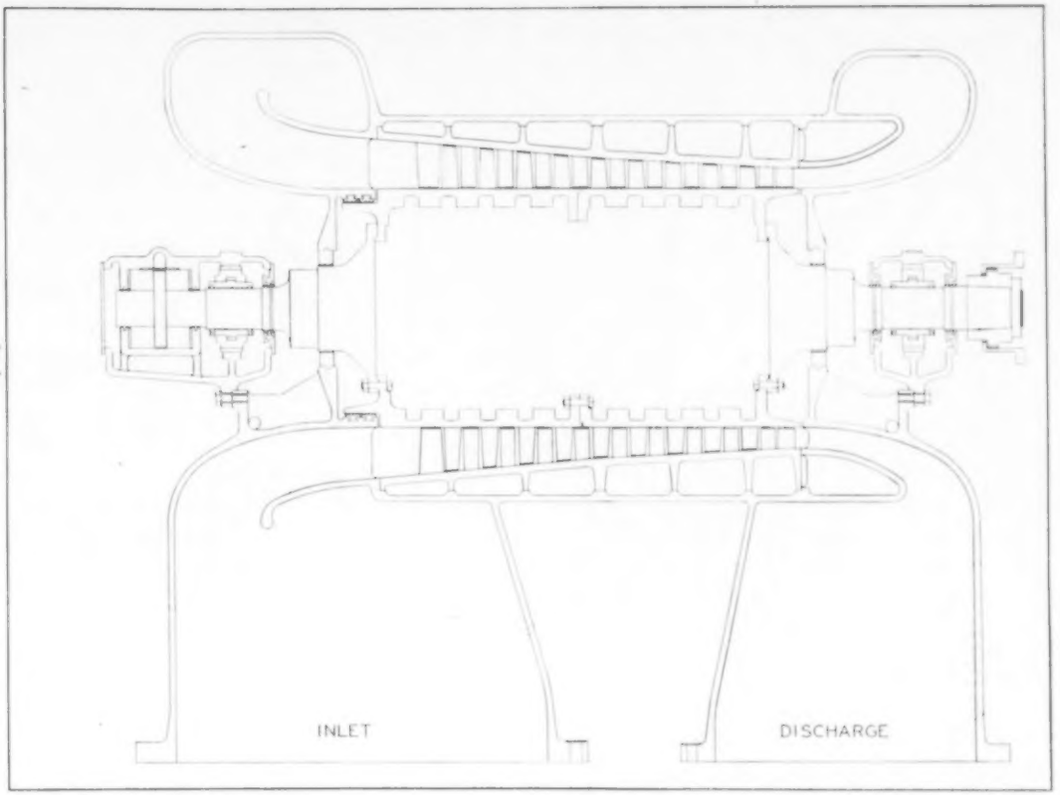


Figure 1 — The axial compressor provides a fairly straight air path.

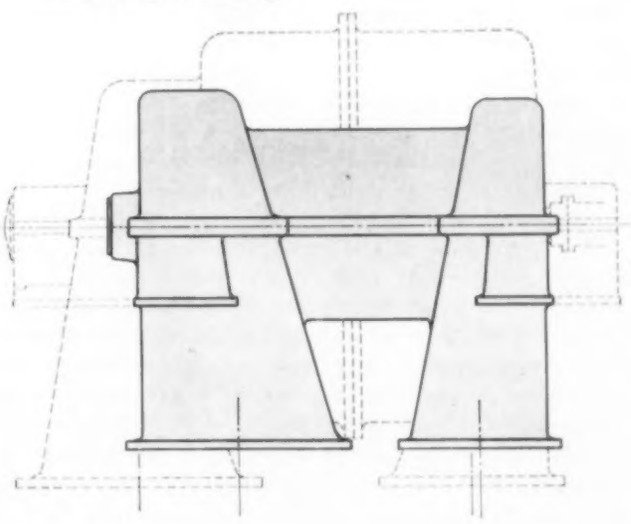
special wear resistant alloys can be used that would not be available where machining is required. Figure 1 clearly shows the efficient, straight-through air path in the axial compressor.

For comparison in this article a blower rating of 100,000 standard cu ft per min (measured at 30 in. of Hga and 60 F) at 30 psig discharge pressure has been selected as being representative of present day large blast furnace blower practice. Standard practice used in sizing the blower for this rating requires an additional inlet volume margin of approximately 10 per cent to handle this same weight of air with inlet conditions varying to 14.4 psia and 100 F. This establishes the rated inlet volume of this blower as 110,000 cfm. Figure 2 shows the comparison in size of a 110,000 cfm, 30 psig axial compressor and a comparable centrifugal blower with the shaded portion outlining the axial unit.

Having established the type of unit required to adapt the axial flow principal to ratings required for blast furnace service, the performance characteristics of this type of compressor are next due for consideration. Figure 3 shows the pressure-volume and the BHP-volume characteristic curves for this same 110,000 cfm, 30 psig axial compressor for various speeds. At first glance, the steep pressure-volume characteristic at 100 per cent speed may appear to be unsuited to blast furnace blowing when compared to the familiar flat pressure-volume curve of the centrifugal blower. In fact, this characteristic has largely been responsible for the general feeling in the past that the axial compressor was not suitable for this service. However, a quick comparison of this sort does not reveal the true picture and a careful study of the complete operating range of the axial compressor reveals several marked advantages favoring this type of compressor for blast furnace service.

To obtain a clearer picture, the familiar centrifugal blower performance curve is superimposed in dotted lines over this axial curve in Figure 4 with both types of units being designed for the same volume and pressure rating. A study of these combined curves reveals that the axial covers the same pressure range under variable speed as does the centrifugal with the added advantage of additional pressure head being available at full speed. It also reveals that the stable range (i.e. the area to the right of the pumping limit line) is approximately one-half of the stable range available with the centrifugal. Finally, and the most important, is the reduced horsepower required to operate the axial compressor.

Figure 2 — The axial compressor requires less room than the centrifugal blower as indicated by the shaded section of the drawing.



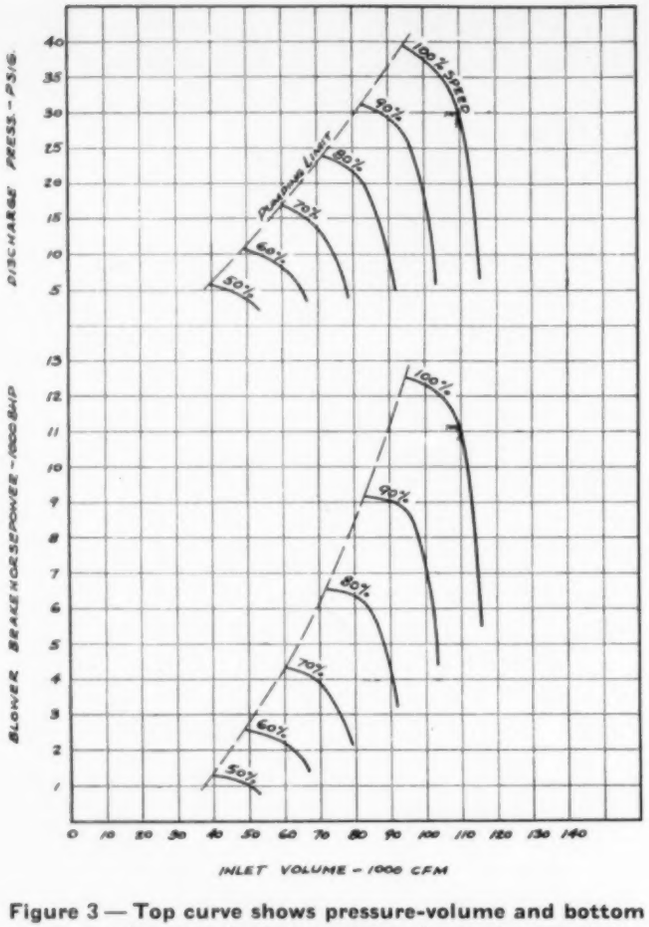


Figure 3 — Top curve shows pressure-volume and bottom curve shows brake horsepower-volume characteristics for a 110,000 cfm 30 psig axial compressor.

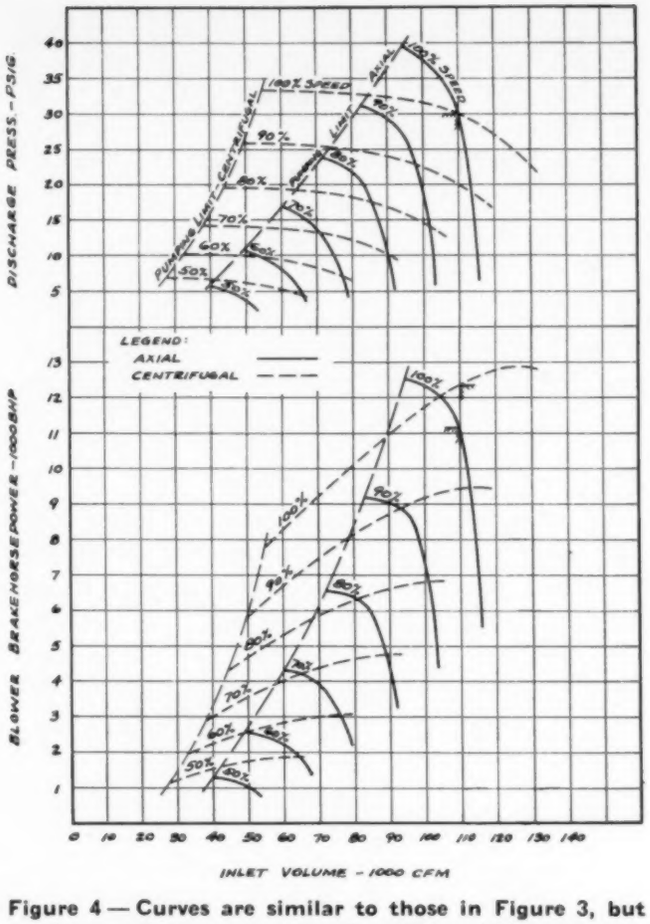


Figure 4 — Curves are similar to those in Figure 3, but have performance curves of centrifugal blower superimposed to provide a direct visual comparison.

At the rated point of 110,000 cfm and 30 psig, the expenditure of horsepower for this compression is about 11,150 hp for the axial against approximately 12,350 hp for the centrifugal, a saving of 1200 hp or 9.7 per cent over the centrifugal unit. This type of horsepower saving not only exists at the rated point but extends throughout the entire operating range of the axial compressor.

The additional pressure head that is available at the 100 per cent or maximum operating speed of the axial compressor provides a large reserve of pressure that is available, if needed, to overcome increased furnace resistance. In a constant air weight or essentially constant volume operation such as is encountered in blast furnace blowing, where it is imperative that the desired volume be forced through the furnace, the steep pressure-volume characteristic of the axial compressor is actually preferable to the conventional relatively flat characteristic of the centrifugal blower.

As previously pointed out, the axial compressor possesses about half of the stable operating range of the centrifugal. However, this is not as critical as it may appear since to overcome this an automatically operated blow off valve must be added to the blast furnace blower control. This in turn completely eliminates the possibility of putting the blower into surging, even under unusual low volume conditions which sometimes even plague operators of centrifugal blowers not so equipped. Figure 5 shows a schematic control arrangement proposed by one regulator manufacturer for a complete blast furnace control for an axial compressor incorporating such a blow off valve.

With reference to Figure 5, the control shown is a standard blast furnace control with automatic compensation for changes in atmospheric pressure and temperature, but with a blow off valve and an automatic valve regulator and operating cylinder added. The purpose of the blow off valve is to maintain a sufficient volume of air going through the axial compressor to keep it operating within its stable region by bleeding air from the compressor discharge during times when volume and pressure conditions required by the blast furnace fall in the unstable region of the compressor. With reference to Figure 3, it is essential that the blow off valve operates in such a manner as to remain closed during stable operation, to begin to open as the pumping limit is reached, and to open progressively further as the volume is reduced below the stable volume. The basic factor to control this valve operation is, therefore, the actual inlet volume to the compressor which is measured by the inlet venturi that is normally furnished as a part of the regulator blast furnace control. In Figure 5 it will be noted that the venturi pressure differential, which normally is used by the constant volume regulator of the standard control to vary the driving turbine speed, is also used by the blow off valve regulator as the basis for operating this valve.

Again referring to Figure 3, it will be noted that the inlet volume at which the blow off valve should begin to open is not constant but varies depending upon the

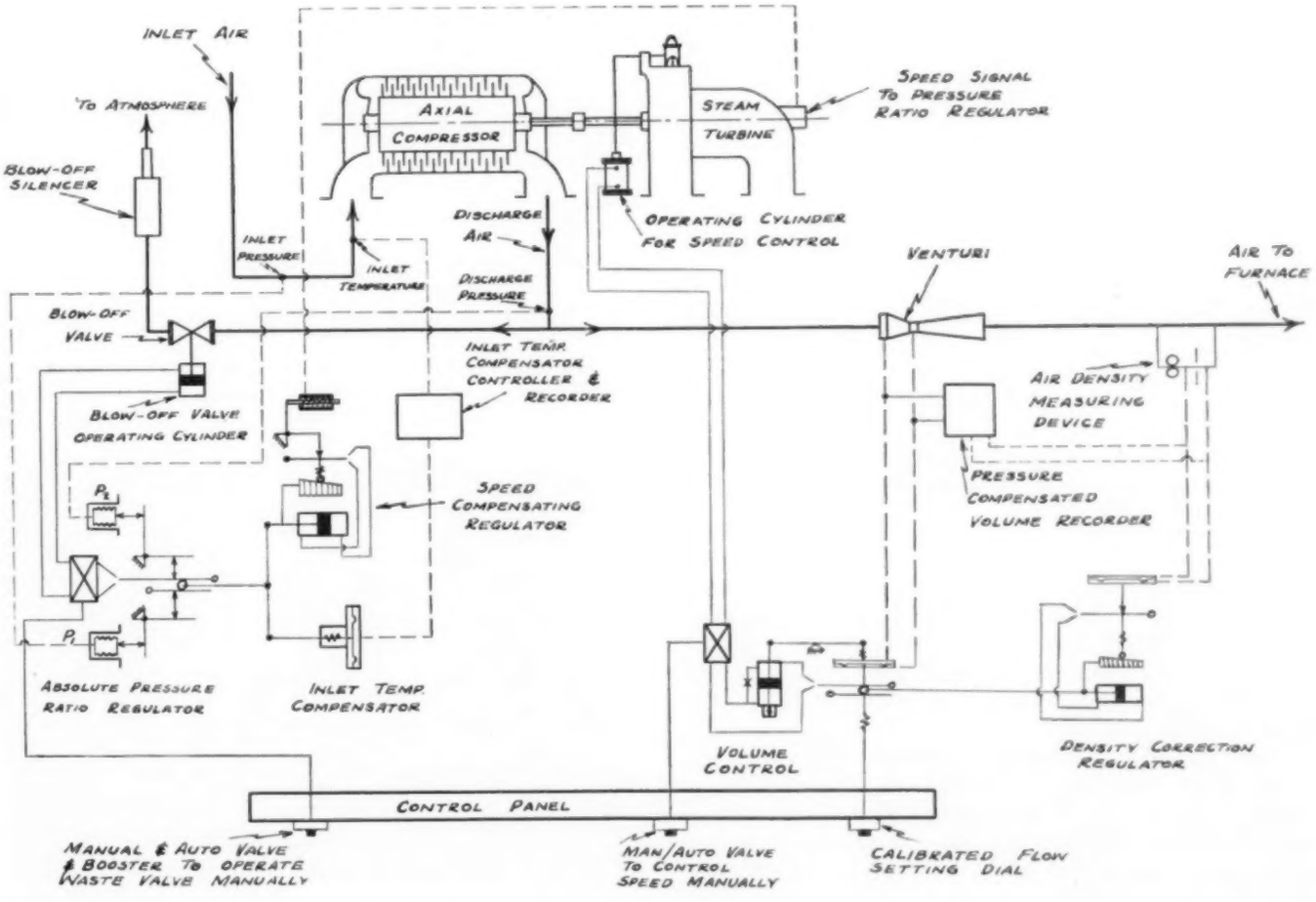
speed at which the axial compressor is operating. It will also be noted that due to the steep pressure-volume characteristic curves for the axial compressor, the pumping limit is defined by a definite discharge pressure for each speed. Accordingly, the discharge pressure can be used to establish the inlet volume at which the blow off valve should begin to open. By referring again to Figure 5 it is noted that a suitable discharge pressure adjustment is made in the blow off valve regulator to control the valve opening to correspond to the exact pressure and volume conditions in the compressor.

Finally, since the discharge pressure developed by the axial compressor at a given speed is also affected by changes in the density of the inlet air, the inlet air density measurement of the standard blast furnace blower control that corrects the turbine speed control regulator to maintain a given standard volume also is used to adjust the blow off valve regulator. This final adjustment to the blow off valve regulator insures that at all times the blow off valve, when once set, will begin to open along the exact pumping limit characteristic line under all conditions of operation and will keep the compressor operating in its stable region at all times without opening this valve prematurely and wasting power. With this automatic blow off control, the narrow stable operating range of the axial compressor is eliminated and no longer becomes a factor in determining the suitability of the axial compressor for blast furnace service.

Up to this point, the discussion has been limited entirely to the axial compressor unit alone. In combination with the driving turbine two additional advantages become apparent. The most important of these is the higher rated speed of the axial since the unit under consideration in this article has a rated or 100 per cent speed of 3600 rpm compared with a rated speed in the neighborhood of 2600 to 2700 rpm for the comparable centrifugal blower. This higher design speed for the turbine results in a lower water rate, which in turn means additional steam flow economy favoring the axial compressor. The second advantage arises through the steep pressure-volume characteristic curve of the axial and the essentially constant volume operation in blast furnace service. Referring back to Figure 4, constant volume operation is represented by a vertical line on the pressure-volume portion of this curve at the volume being maintained by the control. Over a given pressure range at this constant volume, it will be noted that the speed of the axial compressor is reduced below the rated speed less than is the case with the centrifugal operating over the same pressure range. This again means improved operating economy for the turbine driving the axial compressor since it will be operating closer to its rated speed during normal operation.

Figure 6 shows the comparative performance of the centrifugal blower and axial compressor similar to Figure 4 but plotting steam flow to the driving turbine instead of horsepower required by the blower. The figure also shows the extension of the stable operating

Figure 5 — Schematic control arrangement for blast furnace control using an axial compressor.



range of the axial through the use of the automatic blow off valve described above. For this article, a steam condition of 600 psig, 825 F total temperature and 28½ in. of mercury vacuum has been used in plotting this and following curves showing steam flow. The advantage of the automatic blow off valve is well portrayed in this curve, and with this valve the axial compressor actually provides a greater operating range than has been available with the standard centrifugal blowers.

The steam flow vs volume curves in Figure 6 combine all of the advantages of the axial compressor and its higher speed driving turbine that have been discussed above. Here the final improvement in steam consumption with the axial is readily apparent, especially at the rated point as indicated by the shaded angles. At this

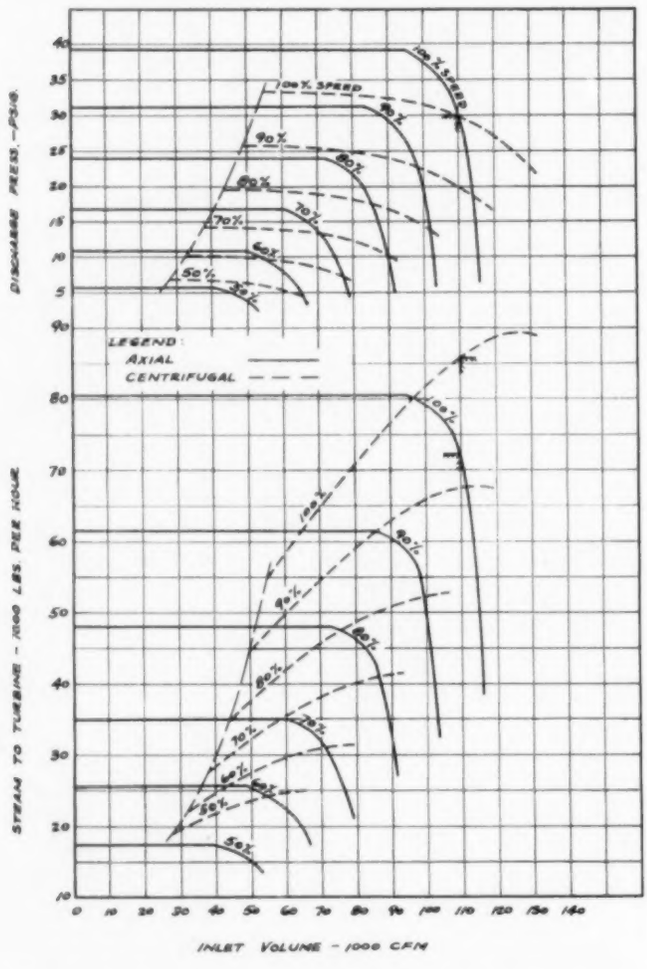


Figure 6 — The automatic blow-off valve extends the stable operating range of the axial turbine.

rated operating point of 110,000 cfm inlet volume and 30 psig, the steam flow required by the centrifugal unit is approximately 85,800 lb of steam per hr as compared to a steam flow of about 72,100 lb per hr to the axial unit. This is an actual saving of 13,700 lb of steam per hr or about 16 per cent.

For a complete comparison of the steam flow economy of the axial compressor over the centrifugal blower, Figure 7 shows a plot of the steam flow vs inlet volume for various constant discharge pressures from the blower. It will be noted that, except for a very small range

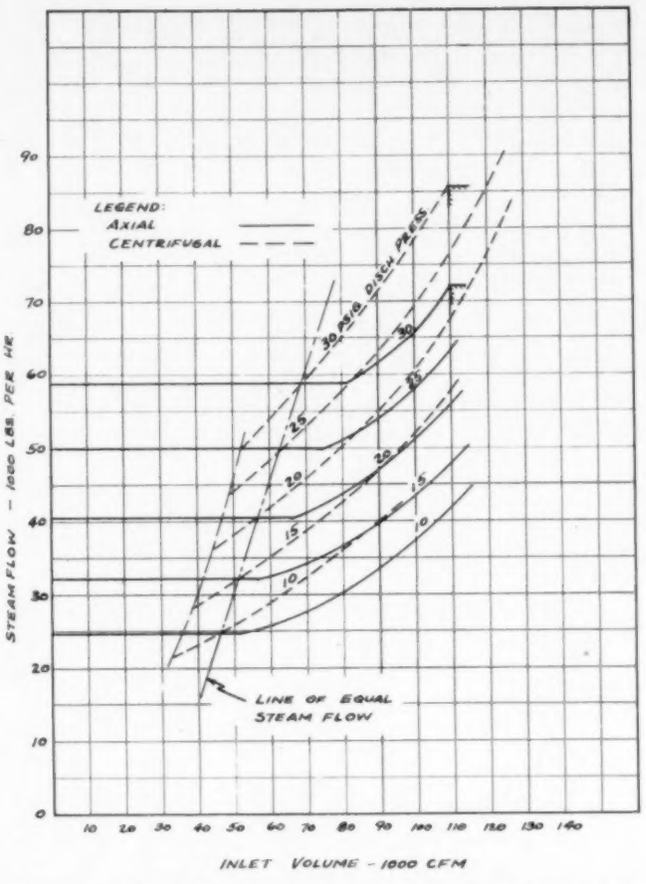
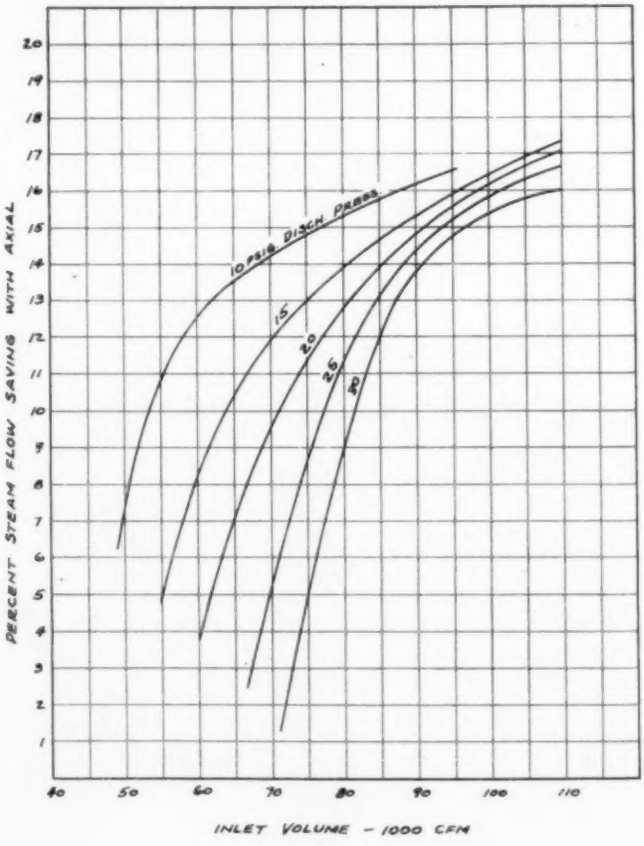


Figure 7 — The axial compressor requires less steam than does the centrifugal unit as shown by the line of equal steam flow.

Figure 8 — Steam flow savings at various flows and pressures are given in this graph.



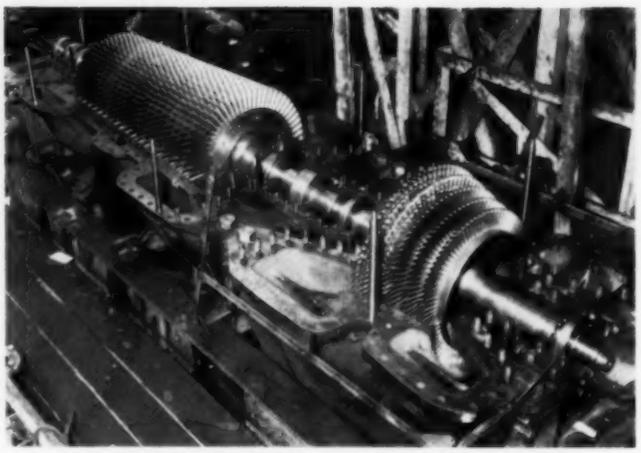


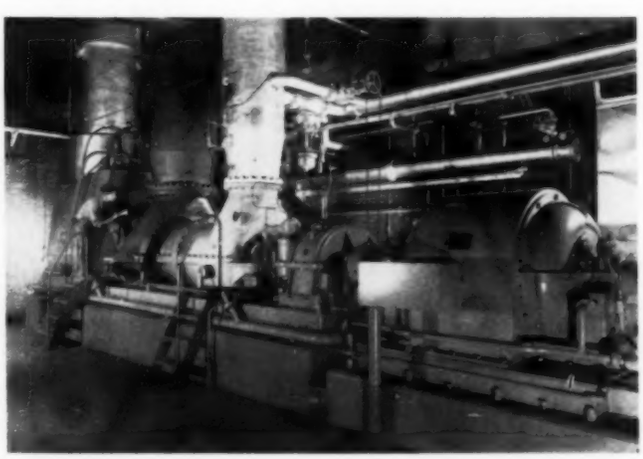
Figure 9 — The top half of the casing has been removed from this 40,000 cfm axial compressor and gas turbine.

near the normal pumping limit line of the centrifugal blower, the axial compressor requires substantially less steam for its driving turbine than does the centrifugal unit for the same volume and pressure compression load. Figure 8 shows this steam flow saving as a percentage of the steam that would be required to drive a standard centrifugal unit.

Now, the question naturally arises as to just what this steam flow economy means in the cost of furnishing air to a blast furnace. The initial cost of purchasing and installing an axial compressor is comparable to that of a similarly rated centrifugal blower. Also, experience indicates that the cost of replacement parts for both an axial and a centrifugal are comparable. The economic comparison between the axial and the centrifugal, therefore can be limited to the actual cost of the operation of each type of unit. Since furnace operation varies considerably depending upon a number of factors, it is necessary to assume a cycle of operation that will represent an average for the purpose of evaluating this reduced steam flow. Accordingly, the following assumptions, which are based on typical operating practice in one midwest mill, are made:

1. Normal blower operation over the period of a year will average 85,000 cfm inlet volume at 22 psig discharge pressure for a unit of the size used as an example in this article.
2. This average operating condition represents 85 per cent of yearly operation.
3. The remaining 15 per cent of the year's operation, representing unusual reduced operating conditions and idling periods, will require equal steam flow for either the centrifugal or axial units.
4. Unit will be down for inspection for two weeks each year.
5. The cost of steam at the turbine throttle is 45 cents per 1000 pounds of steam.

Figure 10 — The axial blower on this gas turbine in an east coast refinery is rated at 4320 rpm, 50 psi gage, 60,000 cfm.



With these assumptions, the yearly saving through the cost of steam with the axial compressor can be calculated as follows:

From Figure 7, the steam flow to both types of units at 85,000 cfm and 22 psig are as follows:

Centrifugal	55,500 lb per hr
Axial	48,000 lb per hr
Saving	7,500 lb per hr

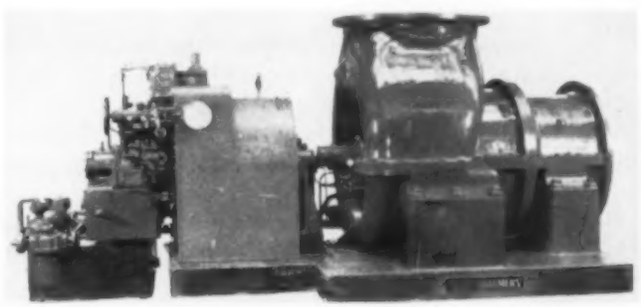


Figure 11 — This 50,000-cfm low pressure axial compressor is used in a gas booster.

Total hours per year	$=24\times30\times12=8640$ hr
Less 2 weeks inspection time	$=24\times14=336$ hr
Operating hours per year	$=8304$ hr
Hours under normal operation	$=8304\times0.85=7058$ hr

Annual operating saving with axial compressor =

$$7058 \text{ hr} \times 7500 \text{ lb/hr} \times \frac{\$0.45}{1000} = \$23{,}820.00 \text{ per year.}$$

This yearly saving based upon the above assumption is, of course, subject to some modification either up or down depending on the variation of each individual furnace from the assumed conditions. In spite of these variations, annual savings of approximately $20,000.00 per unit can be expected.

To get an idea of the cost of furnishing steam to drive a centrifugal blast furnace blower of this size for a year the data from the above example can be used as follows:

Steam cost during normal operation:

$$7058 \text{ hr} \times 55{,}500 \text{ lb/hr} \times \frac{\$0.45}{1000} = \$176{,}274.00$$

Then, assuming that the remaining 15 per cent of the yearly operation, or 1246 hours, will average 30,000 lb of steam per hr, we have an additional cost of:

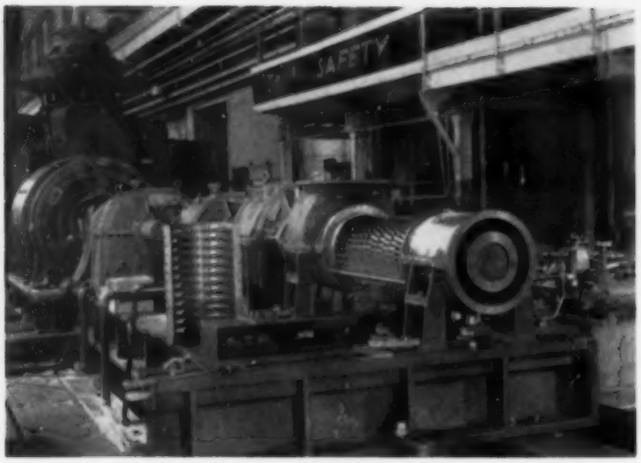


Figure 12 — An 8850-cfm, 11,500-rpm axial compressor unit.

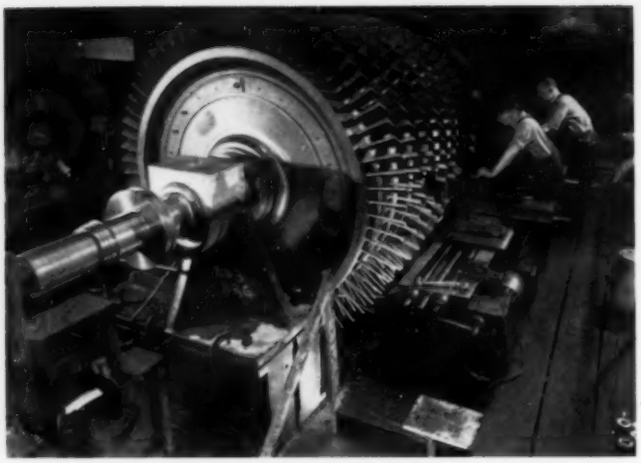


Figure 13 — Illustration shows final trimming cut being taken on the blades in the spindle of an 860,000-cfm axial compressor.

$$1246 \text{ hr} \times 30{,}000 \text{ lb/hr} \times \frac{\$0.45}{1000} = \$16{,}821.00$$

This makes a total yearly cost of $193,195.00 to provide steam to operate a centrifugal blast furnace blower of 110,000 cfm, 30 psig rating. Again, this total cost will vary somewhat depending upon individual operating conditions. Air becomes an expensive ingredient when viewed in this manner and the saving of $23,820.00 per year with the axial or about 12.3 per cent of the total steam cost for a comparable centrifugal offers an operating economy that merits attention.

At the beginning of this article it was pointed out that the axial compressor cannot be considered as a newcomer to American industry. Probably the most outstanding application has been its use in conjunction with a gas turbine as used in the houdry process of petroleum refining. More than thirty of these units in sizes ranging from 16,000 cfm to 60,000 cfm have been furnished by the writer's firm for this service and they have built up an impressive operating record covering a fifteen year period. This operating experience has been obtained in an industry where the problem of down time is looked on as seriously as it is in the steel industry.

Figure 9 shows a shop erection view of a 40,000 cfm axial compressor-gas turbine houdry unit with the top half of the casing removed. The axial compressor is at the left of the picture and is a 20-stage compressor developing 45 psig discharge pressure. The gas turbine for driving the axial compressor is shown in the foreground of this picture. Figure 10 shows an installation view of a 60,000 cfm houdry unit in an east coast refinery. In this picture the gas turbine is at the extreme left with the axial compressor next in line, followed by a speed decreasing gear and an induction motor-generator. A small starting steam turbine is coupled to the motor but is not shown in this picture.

For service with an eastern gas utility, Figure 11 shows a shop view of a large volume, low pressure axial compressor for gas booster service. This is a 50,000 cfm, four stage unit arranged for steam turbine drive and is designed for operation at 5800 rpm. This unit represents another application of the axial design advantages for large volume compression as the single stage centrifugal blower for this same service would require a casing much larger in diameter than is required for this comparable axial unit. Of special interest is the axial inlet to this unit at the extreme right end of the compressor.

For a contrast in axial compressors, Figure 12 shows an 8850 cfm, 11,500 rpm unit set up on the shop test pit and Figure 13 shows the rotor of an 860,000 cfm, 1320 rpm unit during final fabrication. To contrast these two units, the one pictured in Figure 12 has a rotor of approximately 13.5 in. in outside diameter whereas the one pictured in Figure 13 has a rotor about ten times larger. Both of these axial compressors are for aircraft testing service and are installed and operating.

To summarize, the axial compressor as applied to blast furnace blowing compares with the standard centrifugal blower as follows:

The axial compressor:

1. Is smaller, lighter and operates at a higher speed.
2. Has a more limited stable range than the centrifugal blower and requires a blow off valve for wide range operation.
3. Is more efficient throughout its entire range.
4. Is much more economical to operate.
5. Utilizes a higher speed driving turbine.
6. Operates closer to design speed under normal operating conditions.
7. Has additional pressure head available at full speed.
8. Is operated in exactly the same manner as the centrifugal blower.
9. Has adjustable blades that will permit some modification of the rating after installation.
10. Has individually mounted blades that can be replaced in the field.
11. Can be balanced in the field in the same manner as a steam turbine.
12. Can be built for the same standard ratings as the centrifugal blower but favors the larger ratings.
13. Can easily be built for much larger ratings than would be feasible with the centrifugal blower.
14. Has proven itself in American industry and can be recommended to the steel industry without reservation.

LOW INERTIA D-C MOTORS *for* ROLLING MILL DRIVES

By J. H. SCHNEIDER
Section Engineer, Large D-C Motors and Generators
Elliott Co.
Ridgway, Pa.

. . . . low inertia motors increase production, are easier to control and require less power . . . the greatest disadvantage may be higher initial cost . . . .

▲ THE use of special low inertia motors for strip mill drive has been a matter of considerable interest in the industry. Starting with the premise that low inertia in the motors means less accelerating and decelerating time, and thus a greater per cent of the rolling cycle devoted to full speed operation, the use of such motors would appear to insure greater output per hour. In addition to the gain in overall time, there is also the further advantage of a smaller scrap ratio because of less off-gage or off-temper material rolled during the starting and stopping periods. However, because low inertia motors are more difficult to build, have closer commutation and heating limits, and in general have higher costs, it becomes of interest to examine the possible mill operating gains in more detail, so as to judge whether the use of these special motors is justified.

In general, it may be said that the effect of any decrease in the starting and stopping time of the strip cycle is more noticeable with short cycles. Thus a mill with a high strip speed or a short length of strip will have more possibility of improvement in overall time than a mill with low maximum strip speed or longer length of strip. It is obvious, then, that these factors as well as a number of others will affect the conclusions to be drawn.

Another general observation may be made that while the inertia of the motors contributes to the accelerating and decelerating time, the inertia of the gears and mill parts must also be considered. Preferably, one should deal with stored energies, particularly when various motor base speeds and gear ratios are considered. It then becomes possible to examine the stored energy of the system with various motors, low inertia type as well as normal design, and for different base speeds, horsepower ratings, and gear ratios, so as to determine the effect on starting and stopping time.

In the following section a typical strip mill cycle is calculated under several possible conditions. This will serve to illustrate the type of study necessary to arrive at reasonable conclusions concerning the use of special low inertia motors.

The writer has assumed a single stand temper mill with the following requirements to illustrate various points:

Maximum strip speed, fpm	2500
Maximum width of strip, in.	56
Recoiler, reel diam, in.	24
Maximum coil diam, in.	72
Gear reduction from motor	2.15/1
Pound-feet-squared, referred to motor shaft	2550
Maximum total tension on strip, lb	12,000
Motor speed, rpm	250/900
Motor horsepower	1000
Mill stand, work roll diam, in.	17 to 21.25
Gear reduction from motor	1.333/1
Pound-feet-squared, total, referred to motor shaft	14,844
Motor speed, rpm	450/800
Motor horsepower, total	1200
Uncoiler, reel diam, in.	20
Gear reduction from motor	2.52/1
Pound-feet-squared, total, referred to drag generator shaft	1024
Maximum total tension on strip, lb	6000
Drag generator speed, rpm	300/1265
Drag generator, kw	300
Accelerating time, sec	10
Decelerating time, sec	10

Short accelerating time will increase total production as the mill will operate at top speed more of the time, hence reduce the time to roll a given length of strip and reduce the amount of off-gage and off-temper strip. A steel strip 0.050 in. thick, 12,050 ft long will make a coil 72 in. OD and 24 in. ID. It would take 310 sec to run this 12,050-ft long strip through the mill at 2500 fpm top speed including 20 sec to accelerate from zero speed to 2500 fpm and 20 sec to decelerate from 2500 fpm to zero speed. Allowing 10 sec for acceleration and

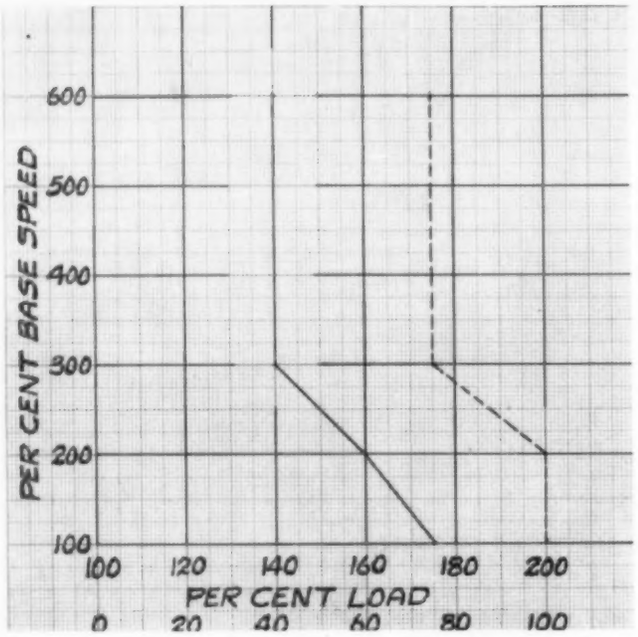


Figure 1 — Chart gives overload capacity of non-reversing d-c motor.

10 sec for deceleration, the total time for this strip to pass through the mill would be 300 sec. This would be a saving of 10 sec or 3.2 per cent per coil by using a mill equipped to accelerate in 10 sec instead of a mill that would take 20 sec to accelerate. The corresponding times for a 6000-ft long strip would be 164 sec and 154 sec. These figures indicate and it can be shown that the smaller the coil length the greater proportion of time required for acceleration. The time for threading, loading and unloading the mill plus other delays must be added to obtain the total time per coil, with the result that the percentage saving in time due to short accelerating time might be halved. The most important saving is the reduction of off-gage or off-temper strip by running at normal operating speed for a larger percentage of the strip length. The 10-sec mill would roll 208 ft of strip while accelerating and 208 ft of strip while decelerating for a total of 416 ft. Similarly, the 20-sec mill would roll a total of 832 ft while accelerating and decelerating. If all of the strip rolled while accelerating and decelerating were off-gage, the 10-sec mill would have 416 ft less off-gage strip than the 20-sec mill. This would be a saving of 3.45 per cent in a 12,000-ft coil or 6.9 per cent in a 6000-ft long strip. Of course, not all of the strip run through the mill while accelerating or decelerating is off-gage or off-temper, hence the percentage saving will be somewhat lower than the above calculated values.

Low inertia motors are required to accelerate and decelerate the assumed mill in 10 sec. Acceleration of these mills requires power. This acceleration power is

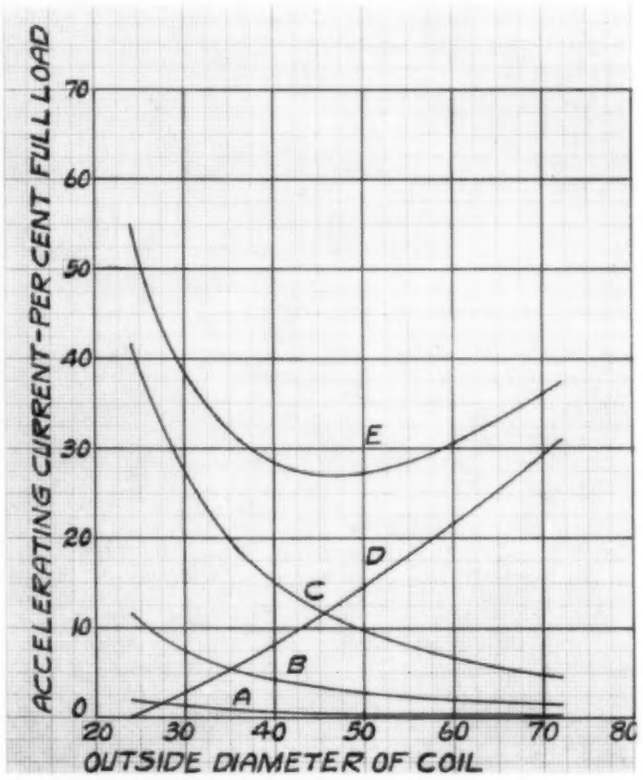


Figure 2 — The worst condition for accelerating the recoiler is the empty reel condition. Curve A is current required to accelerate brake wheel, Curve B is current required to accelerate mill parts, Curve C is current required to accelerate motor, Curve D is current required to accelerate steel coil, and Curve E is total armature acceleration current.

needed in addition to the power required to work the steel. Assuming that the power required to work the steel is 100 per cent of the rated capacity of the motor, the additional power required to accelerate the mill

TABLE I

Frame No.	Armatures	Inertia, pound feet squared		Per cent current to accelerate to 2500 fpm					
				Mill			Recoiler		
		1200 hp 450/800 rpm A	1000 hp 250/900 rpm B	Motor C	Mill parts D	Total E	Motor F	Mill parts G	Total H
7	Single	20,600	.....	59.5	33	92.5	....	....	....
6	Single	11,500	15,500	33.3	33	66.3	70	13.5	83.6
5	Single	8,100	11,000	23.4	33	56.4	49.7	13.5	63.2
5	Double	10,200	13,000	29.2	33	62.2	58.8	13.5	72.3
4	Double	6,600	9,200	19.1	33	52.1	41.7	13.5	55
3	Double	5,400	.....	15.6	33	48.6	....	....	....

imposes an overload on the motor. The overload capacity of non-reversing d-c motors as generally recognized for metal rolling service is shown in Figure 1. The solid curve applies to frequently applied overloads of short duration such as occur when accelerating or decelerating. The dash curve is for occasionally applied overloads of short duration such as occur under abnormal conditions. Essentially a larger motor must be used to obtain overload capacity higher than shown in Figure 1, but a larger motor has more inertia and more inertia means more accelerating current.

The mill and recoiler motors can be built to have any of the inertias as shown in Table I, columns A and B respectively. The armature diameter and frame diameter decrease from the largest diameter tabulated, Frame 7, to the smallest diameter tabulated, Frame 3.

The tabulation in Table I, column A, shows the WK^2 values for a 1200-hp, 450/800 rpm, 600-v, 40 C continuous temperature rise motor. The highest inertia tabulated is for a normal design single armature motor. The highest inertia tabulated for two armatures is for the two normal design motors in tandem or twin drive. The two armatures in tandem have one-half the inertia of the single armature motor. These high inertia motors will cool at base speed without pressure ventilation. The lowest inertia single armature motor and the two lower inertia double armature motors require separate ventilation to cool properly. The lowest inertia double armature motor has one-quarter of the inertia of the highest inertia single armature motor.

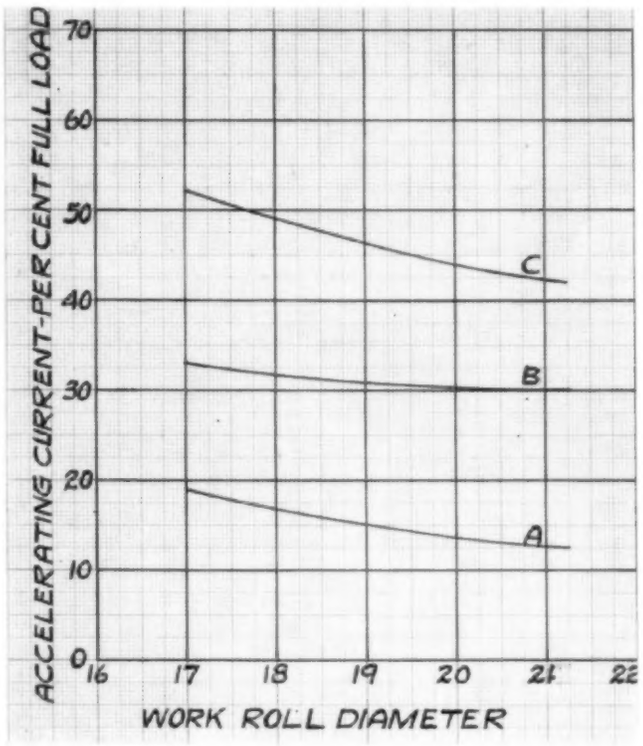


Figure 3 — Mill accelerating current. Curves A, B, and C show current required to accelerate motor, mill parts, and total armature current for acceleration.

The tabulation in Table I, column B, shows the WK^2 values for a 1000-hp, 250/900-rpm, 600-v, 40 C continuous temperature rise motor. All of these motors require separate ventilation to cool due to the low speed. The highest inertia single armature machine and the highest inertia double armature machine could be made self cooling with a longer core and hence higher inertia. The 7 frame cannot be used as the peripheral speed of armature and commutator would be too high. The 3 frame cannot be used as the core would be too long for good practice on mechanical, commutation and ventilation considerations. The hp/rpm of the 1000-hp motor is one and a half times the hp/rpm of the 1200-hp motor.

Table I shows that two motors of half rating with normal proportions can have more inertia than a single motor designed for low inertia.

Motors designed for 60 C continuous temperature rise would have approximately 90 per cent of the WK^2 tabulated for the 40 C machines. Smaller diameter machines require higher temperature rise to be able to obtain low inertias.

The worst condition for accelerating the recoiler is shown by the curves in Figure 2 to be the empty reel condition. If the motor with the highest inertia, 15,500 $lb\text{-}ft^2$ tabulated in Table I, column B, were used the total accelerating current to accelerate to 2500 fpm with the empty reel would be 83.6 per cent of rated armature current as shown in column H of Table I. The empty reel condition for the curves in Figure 2 is when the outside diameter of the coil is equal to the 24-in. reel diameter. This accelerating current added to

Figure 4 — Uncoiler decelerating current. Curves A, B, C, D, and E show decelerating current for the brake wheel, mill parts, two 150-kw drag generators, steel coil and deceleration armature currents only, respectively.

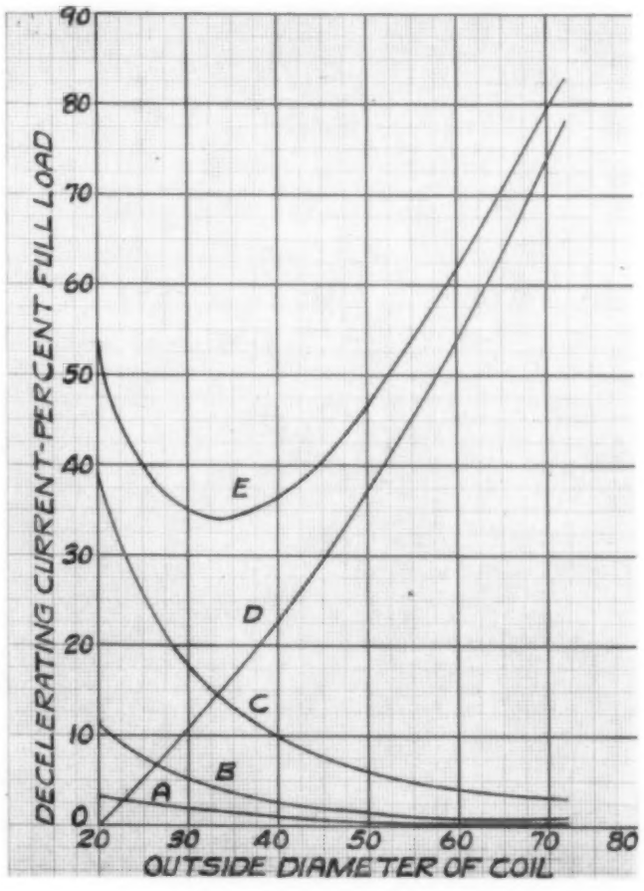


Figure 5 — Typical low inertia motor shaft.

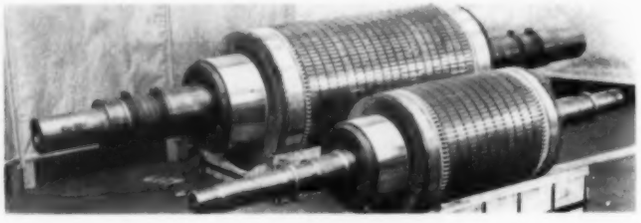


Figure 6 — Two typical long core armatures.

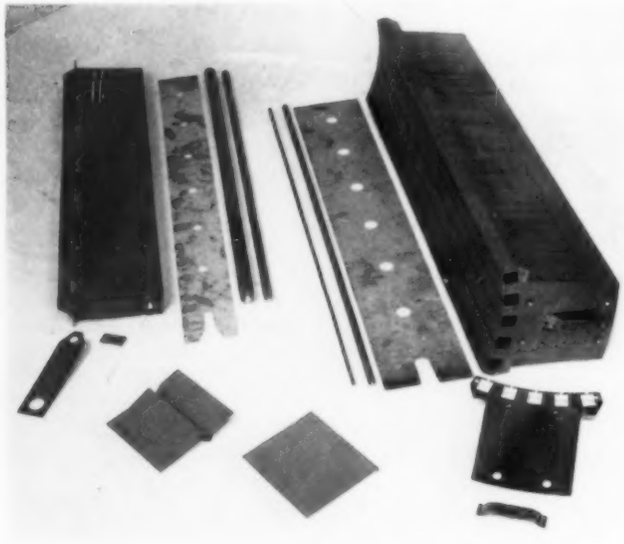
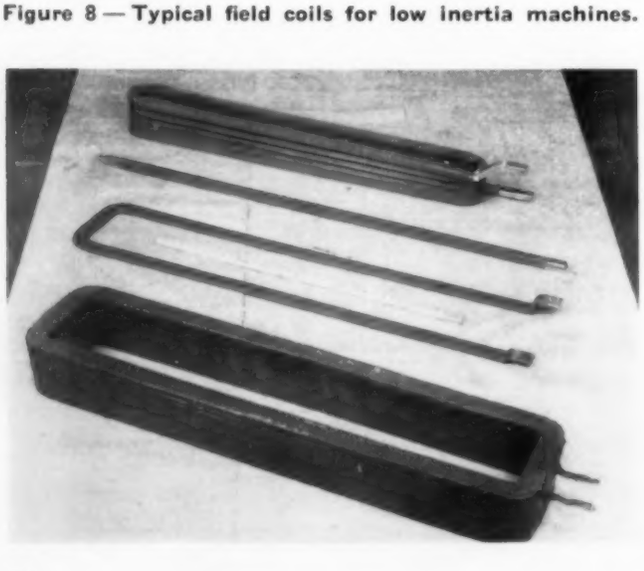


Figure 7 — Illustration shows main pole and commutating pole for long core machines.

Figure 8 — Typical field coils for low inertia machines.



100 per cent current to hold 12,000 pound total tension in the strip while accelerating gives a total load current of 183.6 per cent of rated armature current. This current is much too high for a motor with a weakened field speed 3.42 times its rated base speed. Similarly the other motors tabulated would have total load currents of 163.2 per cent, 172.3 per cent, and 155 per cent of rated armature current while accelerating. The motor with the lowest inertia tabulated is low enough to be satisfactory and would be used for this application. The curves in Figure 2 are plotted for this motor.

The accelerating current of the recoiler could be reduced to 42 per cent of rated armature current by using a motor rated 1000-hp, 200/720 rpm. The gears would have to be changed from 2.15 to 1 to 1.72 to 1 to maintain the same strip speed. This change in gearing would make the mill parts 3950 lb-ft^2 referred to the motor shaft. The inertia of the 200 rpm motor would be 10,000 lb-ft^2 as it would have the same diameter armature with a longer core. The total WK^2 referred to the motor shaft would be 18.8 per cent more. The rated motor torque would be 25 per cent more, and the acceleration (motor rpm/second) would be 20 per cent less requiring only 76.7 per cent as much accelerating current as the 250 rpm base speed motor.

All of the tabulations, calculations, and curves are based on accelerating or decelerating by changing the armature voltage supplied to the motor or drag generator. The recoiler motor field would be set to correspond to a speed of 855 rpm with rated voltage across the armature before starting a new coil through the mill.

The worst condition for accelerating the mill is shown by the curve in Figure 3 to be the 17-in. diam work roll. if the motor with the largest inertia, 20,600 lb-ft^2, tabulated in Table I were used, the total accelerating current to accelerate to 2500 fpm with the 17 in. diameter rolls would be 92.5 per cent of rated armature current as shown in column E of Table I. This accelerating current added to 100 per cent current for working the steel while accelerating gives a total load current of 192.5 per cent of rated armature current. This current is much too high. Similarly the other motors that are tabulated would have total load currents of 166.3 per cent, 156.4 per cent, 162.2 per cent, 152.1 per cent and 148.6 per cent of rated armature current while accelerating. The motor with the inertia of 6600 lb-ft^2 is low enough and would be used. The curve on Figure 3 is plotted for this motor.

The tension in the strip helps to accelerate the uncoiler. But when decelerating, you might say, the drag generators are trying to stop the mill. The uncoiler drag generators must generate enough power to maintain tension in the strip plus power to accelerate. Figure 4 shows curves for decelerating the uncoiler. The highest decelerating current, 81 per cent, is for the full coil condition but as this occurs at almost full field on the motor, it is easy to design for this high overload. Another consideration is that it is not likely that the mill will be decelerated from maximum speed with a full coil. It will be normal operation to decelerate with an almost empty reel. The worst overload to commutate is at the empty reel condition as this occurs at 400 per cent of the rated base speed. Deceleration with the empty reel requires very low inertia drag generators as even then the inertia of the drag generators is much

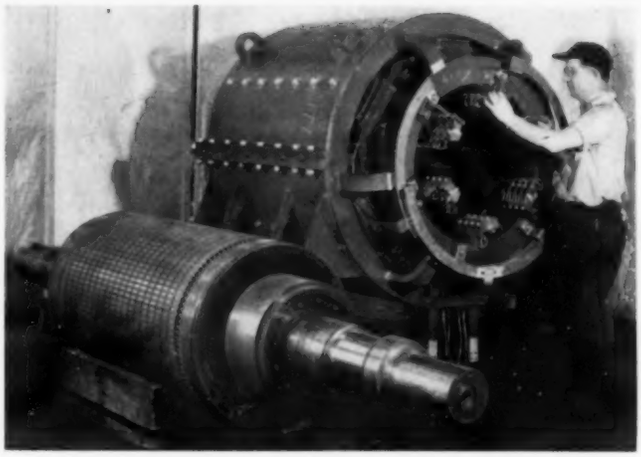
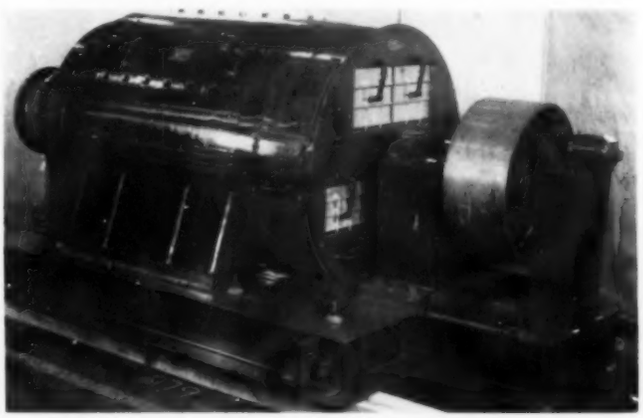


Figure 9 — A complete field and complete armature are shown.

Figure 10 — Illustration shows a complete motor with covers on base.



larger than the uncoiler mill parts. These small diameter drag generators require the use of higher temperature rise (60 C) to obtain the very low inertia that is required.

The curves in Figures 2, 3, and 4 show the per cent accelerating or decelerating current for the various parts of the mill.

Figures 2 and 3 are plotted for 10-sec acceleration from zero speed to a strip speed of 2500 fpm (250 fpm per sec acceleration) for a 56-in. wide steel strip. The per cent current plotted is the accelerating current only and does not include the current to maintain tension in the strip or to work the steel. Curve A in Figure 2 is the current required to accelerate the brake wheel. Curve B shows the current required to accelerate the mill parts. Curve D shows the current required to accelerate the steel coil. The current required to accelerate the motor is shown on Curve C. Curve E in Figure 2 shows the total armature current required for acceleration only. Curve A in Figure 4 is the current to decelerate the brake wheel. Curve B shows the current required to decelerate the mill parts. Curve D shows the current to decelerate the steel coil. The current required to decelerate the two 150-kw drag generators is shown on Curve C. Curve E in Figure 4 shows the total armature current required for decleration only. Curves A, B and C in Figure 3 show the current required to accelerate the motor, the mill parts, and the total armature current for acceleration only respectively.

The low inertia d-c motor has low inertia as compared to a d-c motor with normal proportions. The low inertia is obtained by using a smaller diameter armature with a much longer core. The weight (W) remains approximately the same but the radius of gyration (K) is decreased resulting in lower rotational inertia (WK^2).

Everything has some disadvantages, and low inertia d-c motors are no exception. These motors cost more to build.

The difficulty of obtaining good commutation increases as the diameter for a given rating decreases. This consideration requires more care and time in design and manufacture.

The greatest increase in cost is in the shaft and spider. Figure 5 is a picture of a typical low inertia motor shaft. The yardstick is for comparison. This shaft and spider were machined from a forging. The diameter of the shaft is almost as large as the outside diameter of the spider hub of a normal proportioned machine. The shaft must be this large for sufficient rigidity and strength. The space between the spider arms is required to ventilate the armature.

Extra time and work are required to insure uniform core pressure to prevent bending the shaft. Figure 6 shows two long core armatures.

One main pole and one commutating pole for a long core machine are shown in Figure 7. Additional time is

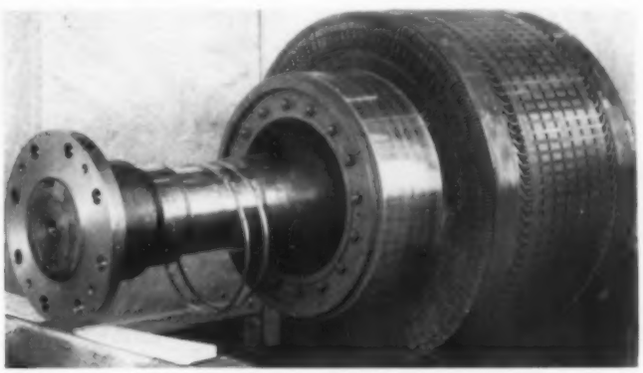
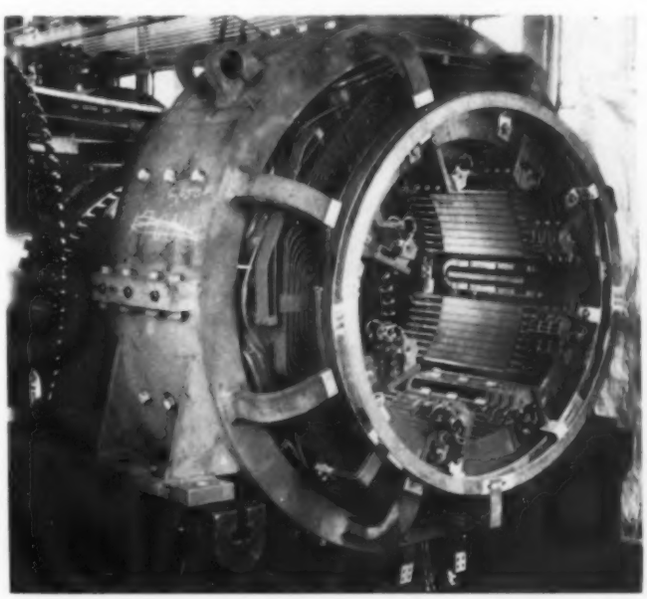


Figure 11 — The armature of a normal motor.

Figure 12 — Field of normal motor.



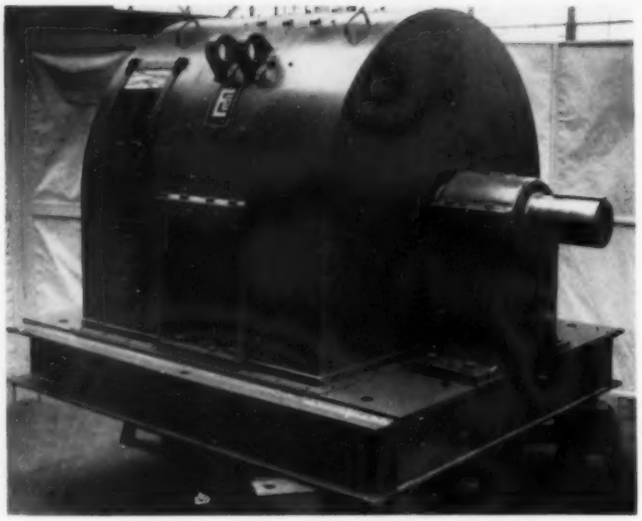


Figure 13 — Typical normal motor.

required to keep these long laminated poles straight.

Typical field coils are shown in Figure 8. From the bottom to the top of the picture they are shunt field coil, series field coil with a yardstick for comparison, compensating field bars (pole face winding) and commutating pole coil. Additional work is required to make these long coils straight and without bulge.

The complete field and complete armature for a motor are shown in Figure 9.

One complete motor with covers and base are shown in Figure 10. The ventilating air is blown into the motor through the duct on the coupling end and discharges from the motor on the commutator end.

Figures 11, 12 and 13 are photographs of the armature, field and complete motor with base respectively of machines with normal proportions. These are included for comparison with the previous pictures.

As the speed of the mills increase, low inertia motors gain in importance. Double the strip speed and the horsepower for working the strip doubles, but the inertia of the mill parts increases approximately four times referred to the motor shaft so that the low inertia motors may have to be two in tandem, three in tandem or twin tandems. Low inertia motors increase production, make it easier for the control to function properly and reduce the demand on the power system.

DISCUSSION

PRESENTED BY

LANIER GREER, Consulting Engineer, D-C Design, Reliance Electric and Engineering Co., Cleveland, Ohio.

W. E. MILLER, Steel Mill Division, General Electric Co., Schenectady, N. Y.

J. H. SCHNEIDER, Section Engineer, Large D-C Motors and Generators, Elliott Co., Ridgway, Pa.

Lanier Greer: Recently much has been said about the use of low inertia d-c motors for rolling mills, planers, presses and for all drives which require rapid acceleration and deceleration of the motors and attendant machinery. There is no doubt that for these applications low inertia motors are very desirable. Mr. Schneider's paper has shown by example and illustration the advantages of low inertia motors as applied to rolling mill drives. It has been pointed out that the way to get a low inertia motor is to reduce the core diameter and increase the core length to keep approximately the same D^2L. Even though the weight of the armature remains about the same, the inertia is reduced because it is proportional to the square of the radius of gyration.

How far should this reduction in diameter and lengthening of the core be carried for the sake of getting low inertia in a motor armature? There are practical considerations which limit the amount of reduction that can be made. Some of these are:

1. Commutation.
2. Heating.
3. Ventilation.
4. Mechanical.
5. Manufacturing.
6. Cost.

All of these factors are related so that any change in one of them affects all of the others.

For a given set of conditions the commutating ability of a motor is proportional to the core diameter, as is the dissipating ability and ventilation. If the diameter is reduced and the stacking of the core lengthened until the factors which limit commutation are reached, the heating will be above the 40 C rise allowed for Class A insulation, in fact it may be over the 70 C rise allowed for Class B insulation. This is because as the diameter is reduced the slot efficiency is reduced and the materials have to be worked harder. The cooling problem is also associated with the mechanical design because as the core diameter is reduced and the stacking is lengthened, the distance between bearings is increased and the factors affecting the mechanical strength of the shaft are changed so that a larger shaft is required. With a larger shaft, a smaller diameter and a longer core, the air ducts through the armature are reduced, resistance to air flow is increased and it becomes more difficult to dissipate the losses of the machine. The long slender armature coils, field coils, and pole pieces, are not as readily handled during manufacture. To reach the minimum WR^2 of course requires more accurate and detailed design and closer manufacturing tolerances. Due to these facts, and also to the fact that production on the low inertia motors is comparatively low, the cost of these motors is higher than for the standard industrial type.

However, in actual operation in many cases more and better materials can be produced if a low inertia motor is used. For this reason serious consideration should be given, by the manufacturer of electrical equipment, to the design and manufacture of motors of this kind. A change in thinking by the designers and builders of motors will very materially help solve some of the difficulties which are presented by the low WR^2 requirement. In general, motor manufacturers have for many years thought in terms of d-c motors as having a core length approximately one-half to one times the diameter. Designs have been made with these proportions; tools have been provided for this kind of design. The

railway motor and the mill type steel mill motor are two exceptions, but in general throughout the motor manufacturing industry, the long core, small diameter, motor has not been used.

Our company makes every effort to take advantage of the new insulating materials, better electric steels, higher temperature grease, better commutator copper, and all other help which modern science can give to make possible the goal of being able to do more work with less material at a lower per unit cost. To make full use of these factors we are:

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Using continually improved designs.

Using new tooling methods in manufacturing.

With these new considerations, it is not too difficult to go a little further and design and build the low inertia motors which are required for steel mill and other special uses of this kind. In fact, in some cases, this has already been done.

W. E. Miller: It is interesting to note that there are a number of mills now in service and now being built capable of speeds in excess of 5000 fpm. The use of low inertia motors, together with proper regulating systems on these mills, means fewer mill delays and safer working conditions for mill operators.

A fast stop after a strip break reduces the possibility of damage to work rolls and back-up rolls and the possibility of injury to operators. During a fast or emergency stop, the drives should be braked by the motors pumping back into the power system right up to the occasionally repeated overload rating of the machines.

The problems and limitations associated with applying motors to really high speed temper mills and tandem cold reduction mills have not been discussed. On today's high speed mills the range of gear ratios and motor speeds for the high speed stands are somewhat restricted. Direct drives or speed increasing gears are used rather than speed decreasing gears. Motor speed may be the highest at which the required horsepower rating can be built without the machine cost increasing. On such mills the stored energy of the motor becomes a small part of the stored energy of the system if a step-up gear is used.

On the 6000 fpm tandem cold reduction mill at Jones & Laughlin Steel Co., less than 16 per cent of the system energy is stored in rotating parts of the double twin driving motor. On such a drive, changes in the motor inertia have small effect upon the time required to accelerate or decelerate the drive.

In fact, the time may be decreased appreciably only by increasing the motor horsepower. Whether the short time overload rating or the rms rating, or both should be increased depends very much upon the case at hand.

On a modern high speed temper mill, the rating of the uncoiler drive may have to be increased beyond that required for strip tension in order that in an emergency the drive may be decelerated in a reasonably short time.

Referring to today's speeds, I do not believe that it is any longer safe to say that low inertia motors gain in importance as the speed of the mills increase. The finishing speeds of today's mills are so high that this cannot be accepted as a general philosophy, but the case in question must be studied.

J. Henry Schneider: I would like to ask Mr. Miller if these motors he is referring to are top speed operating machines, or whether they have lowered the base speed to keep the stored energies down. Other than that, I agree with both discussions. They are very well taken, and are of interest.

W. E. Miller: J & L machines, on the last stands, have approximately two to one speed range by field control. The 16 per cent that we are talking about is stated at the top speed, and all those figures are given in an AISE article, presented before this convention, and published in the 1950 Proceedings of the AISE, p 67, entitled "Electric Equipment for Rolling Cold Strip at 70 Mph."

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ASSOCIATION OF IRON AND STEEL ENGINEERS, 1010 EMPIRE BLDG., PITTSBURGH 22, PA.

SOME ASPECTS OF SOAKING PIT OPERATION

By F. H. GRAHAM
Chief Operating Engineer
Amsler-Morton Corp.
Pittsburgh, Pa.

. . . . good pit operation requires not only a good furnace but one of the correct size for the requirements of each particular plant . . . .

▲ THE object of this paper is to develop and discuss points that may be helpful in obtaining good soaking pit operation. However, before it is possible to have good operation, it is necessary to have a good soaking pit. A definition for a good pit, the writer believes, is one that best meets the needs and peculiar requirements of the plant in which it is already located or is to be installed.

FUNDAMENTAL REQUIREMENTS

First of all, the pit should be of the proper size and have the proper holding capacity for the maximum charge intended. As to some of the basic requirements, a pit furnace should have substantial wall construction, encased in steel plate to prevent air infiltration, reinforced with structural members and provided with walkways and stairways for accessibility to all parts.

The walls should consist of, say, 18 in. suitable refractory materials to meet the usual soaking pit conditions and be well insulated. The walls may either be straight or cambered. If straight, then wall ties are a practical necessity. If cambered walls are used, the camber should be 4½ in. for short walls, say, up to 12 or 15 ft, and 9 in. if the walls are longer than 15 ft. The camber gives an arch effect and helps to hold the wall in its original position.

If common or party wall construction is used between pits, the walls should really be 42 in. thick and of refractory materials similar to the other walls. It is the writer's observation that common wall construction is not only more economical in first cost, but gives better service with less maintenance than the outside walls. This is due primarily to the fact that it has heat on both sides instead of just one.

The top of the walls should be capped with a curb tile designed to provide a suitable sand seal trough for containing the sealing sand.

The sealing sand should be as near pure silica as possible, so it will have a high fusion point; and be sufficiently large in grain size that it will not blow easily or seep away. It should be sized through ¼ in. mesh over No. 10 mesh screen for best results.

It may be well to stress the importance of maintaining the proper amount of sand in the seal trough. In the first place, it is important that the design should facilitate rather than hinder the maintenance of sand seals. The use of the low rail type cover crane provides best access to sand seals and easy accessibility is the first essential to good maintenance. Improperly serviced sand seals lead not only to high cover maintenance but interfere with well controlled quality heating and good pit operation.

The cover should be of flat arch construction. If the pits are narrow a sprung arch can be considered. Monolithic covers made of rammed plastic materials and supported by properly spaced refractory hanger brick are being used or tried out as an alternate to the regular flat arch brick construction by a good many plants. Headway is also being made with castable materials.

The cover frame must be rugged and have replaceable sand seal castings or plates attached to the lower outside edge of the cover frame. The type of seal casting designed for maximum surface radiation is believed to be the most satisfactory and to give the longest life.

WASTE HEAT RECOVERY EQUIPMENT

Waste heat recovery is very important to most plants. It may be accomplished by waste heat boilers, recuperators or regenerators. Generally speaking, it is believed that recuperators or regenerators built integrally into the soaking pit structure have a definite advantage over remotely located recuperators and waste heat boilers from the standpoint of overall economy in fuel. A closely integrated construction is particularly valuable in a soaking pit with its relatively short period batch type operation.

Regenerators give a very satisfactory air preheat, but the necessity of reversing the flow of fuel and air to the checkers causes a loss of heating time and com-

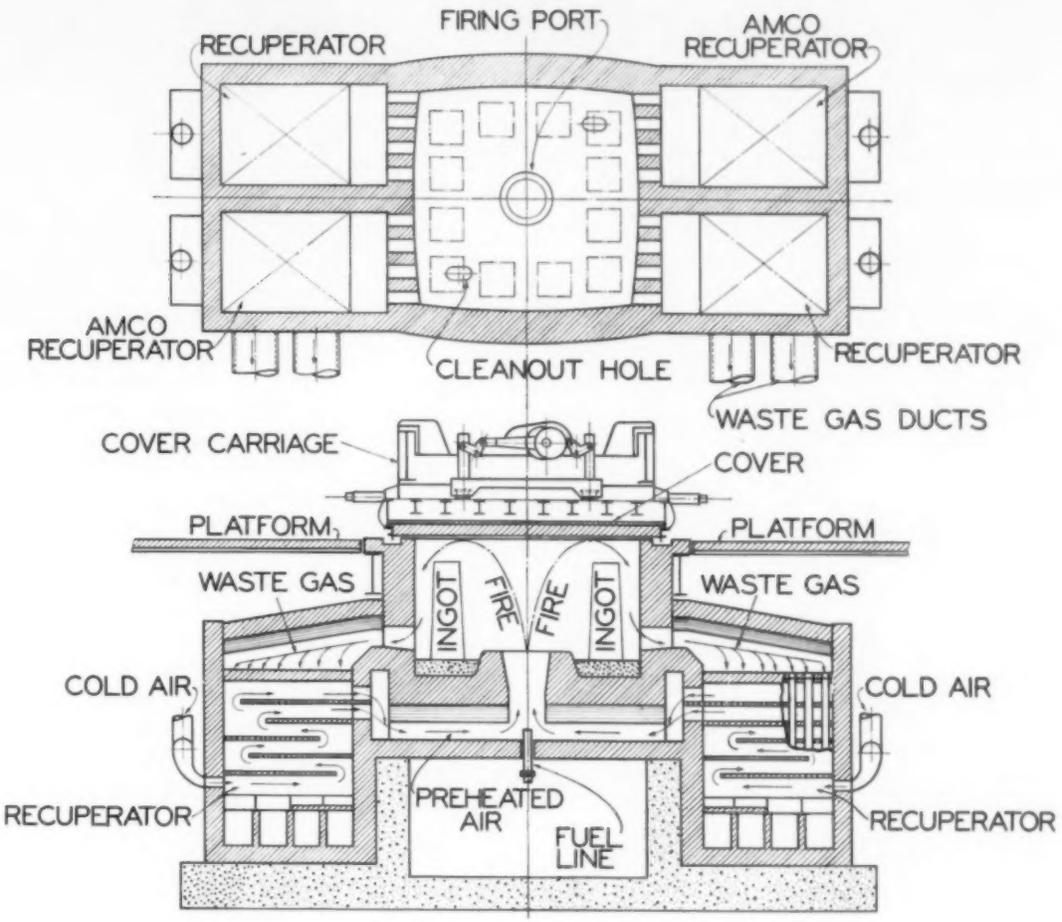


Figure 1 — Cross-section through the pit proper and the recuperators of bottom fired soaking pit. The arrows indicate the path of the waste gases and preheated air.

plicates the automatic control set-up. There are several periods, small to be sure, in every hour that the fuel flow is zero, therefore heating time is lost as compared with a continuous fuel flow in one direction as in the recuperative furnace.

Another objection to the regenerative design is that the same ports used for both firing and exit of gases cannot be designed for best results for both purposes.

The types of pits with which the writer is most familiar have recuperators built integrally into the furnace structure. See Figures 1, 2, 3, 4 and 5. In this design there is a minimum temperature loss between the pits and the recuperators. Likewise, there is a minimum temperature loss in the preheated air between the recuperator and the burner. The preheated air temperatures range between 1300-1350 F for natural gas, 1400-1550 F for CO gas and oil and from 1650-1850 F for 135 Btu mixed gas and straight blast furnace gas. This results in waste gas temperatures at the stack of 800 to 850 F for the high Btu fuels and 1150 to 1250 F for the low Btu fuels. With this low stack temperature, furnace pressure control dampers, made of a relatively low alloy cast iron, have a life of from 8 to 10 years. And the design permits the application of draft and furnace pressure control dampers for each individual pit furnace.

AUTOMATIC CONTROLS

Automatic controls for temperatures, fuel-air ratio, furnace pressure, and fuel shut-off and on, are essential. These may be either electric, hydraulic or pneumatic.

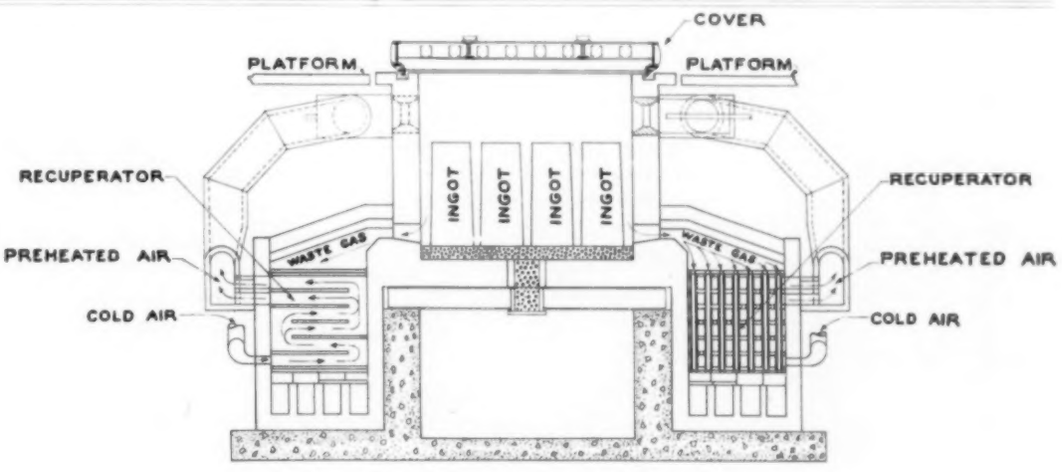


Figure 2 — Cross-section through the pit proper and the recuperators of two-way fired soaking pit.

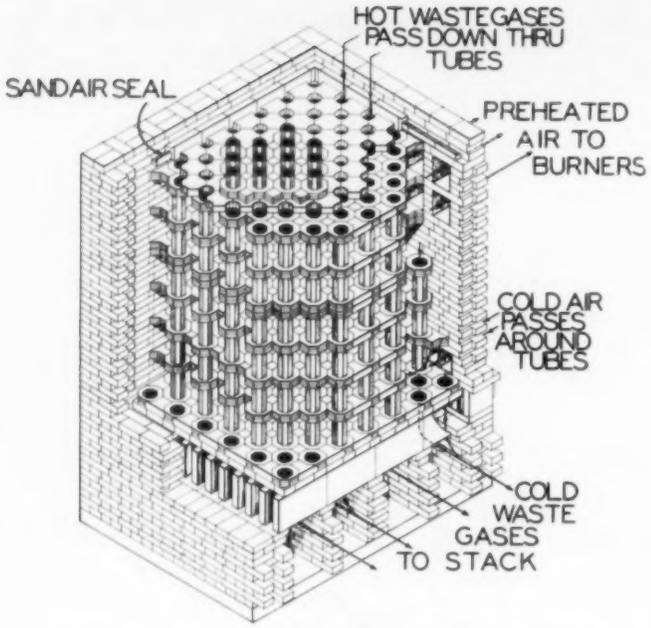

HOT WASTE GASES PASS DOWN THRU TUBES
SAND AIR SEAL
PREHEATED AIR TO BURNERS
COLD AIR PASSES AROUND TUBES
COLD WASTE GASES TO STACK

Figure 3 — Isometric view of recuperator chamber.

They have all been proven by years of service and it is more a matter of choice or of meeting some peculiarity in a given plant as to which one to select. Automatic controls are tools to be used by the heater to aid him in doing a better job of heating and not to relieve him of any of his responsibilities.

CAPACITY OF THE PIT

It may be well to give some consideration to the ingot setting capacity of the pit. For a new installation it is one of the first things to be decided because, from an operating standpoint, it is one of the most important.

Depending upon the capacity of the open hearth or electric furnace, it is generally considered to be the best practice to either charge the entire heat into one pit or divide it between two or three pits, each pit having a full normal charge without any ingots remaining.

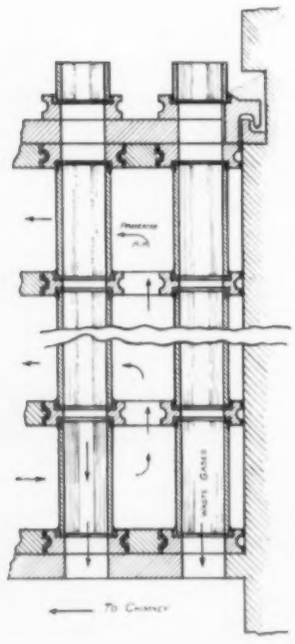


Figure 4 — The stub tile at the top of the recuperators are an improved feature to increase the effective life of the recuperator by preventing slag and "carry over" from choking the top opening of the tubes.

The pit must also have the capacity to accommodate the various sizes of ingots made in the melt shop. Generally speaking, if the pit has sufficient hearth area for the smallest size ingots, it will have plenty of area for the larger ones. A good rule to follow is that the total area of the actual ingot coverage should never exceed 35-40 per cent of the total pit hearth area except in cases where the pit is being used to store the ingots over week-ends. There is an optimum or most economical charge for any given pit which will result in the maximum tons per hour heated. This is indicated by the curve plotted between number of ingots and tons per hour heated shown in Figure 6.

The question of whether the pit should be large or small must be decided by the economics and requirements for each particular plant.

Assuming a 230-ton open hearth, it would hardly be considered good practice, except in very unusual cases, to build a soaking pit for a 230-ton normal charge. The question is whether this charge should be divided between two or three pits. In the case of two pits, each pit would have to accommodate 115 tons as a normal charge, and in the case of three pits the normal charge would be 77 tons each.

Assuming that a certain shop requires a total setting capacity of 1400 tons of ingots: Compare a 12-pit installation, each pit having a setting capacity of 115 tons, with an 18-pit installation, each pit having a setting capacity of 77 tons. The logical layouts would be: for the 12-pit job either six 2-hole rows or four 3-hole rows, and for the 18-pit job, probably six 3-hole rows.

The advantages of the large or 115-ton pits would be:

1. The first cost for an equal setting capacity would be less due to fewer walls involving refractories and steelwork and only two-thirds as many controls and burners.
2. Less shop floor area is required.
3. Less maintenance due to less brickwork and fewer burners, controls, instruments and thermocouples.
4. Less bottom making.
5. Possibly fewer heaters and bottom makers to man the job.

The advantages of the small or 77-ton pits would be:

1. More flexibility of operation and a higher load factor. In other words, less idle time because charging could be started again before all the ingots of the previous open hearth heat are drawn. This would result in a higher production rate.
2. Less overall idle time if a pit were down for repairs.
3. The same would be true of bottom making. While there are more bottoms to make, each unit is smaller and the idle capacity would be less at any one time.
4. When it is necessary to roll only a fraction of a heat to meet a certain schedule of orders and hold the remainder in the pit, less pit hearth space would be idle in the smaller pit layout.

The number of pit cover cranes would not be a factor in this comparison because the number required is usually equal to the number of ingot cranes required by the shop.

Figure 5 — Stub tile is shown in place.

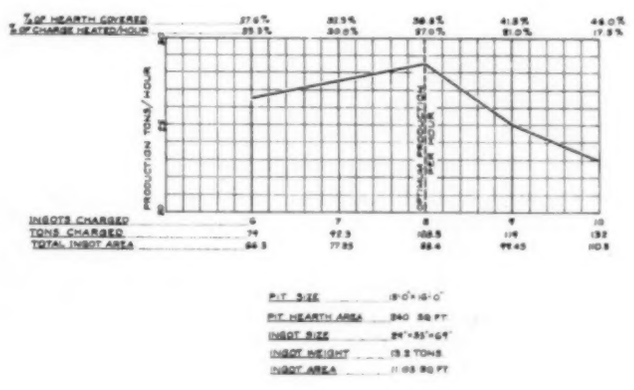
Any objections to the large pit, on the premise that during rolling it is sometimes necessary to stop because the last few ingots have dropped in temperature, are not well founded. Based on the writer's observations and experience, if the pit is equipped with the proper automatic controls and is properly operated, there is no reason for any drop in ingot temperature up to the last ingot. The rate of rolling is, naturally, a factor. However, with the automatic system for stopping fuel input and closing the stack damper when the pit cover is lifted, there is no drop in ingot temperature at rolling rates up to 30 ingots per hour. This fuel shut-off system gives the ingot crane operator immediate clear vision which eliminates lost time. It also prevents air being drawn into the pit and starts fuel flow the instant the cover is lowered. Actually, more heat is introduced when the cover is down than is lost when the pit is open.

Therefore, while every plant has its own particular local conditions, a very common one being space limitations in one form or another, generally speaking, the best overall solution to proper individual pit capacity may be found by balancing or comparing the lower first cost of the large pits with the necessity for flexibility of the smaller pits.

COMBUSTION

Combustion of fuel should, if at all possible, be completed within the limits of the pit proper and not carried over into the flues, recuperators, or regenerators. The type of flame, whether sharp or soft, oxidizing or reducing, should be determined on the basis of that most satisfactory for the type of pit involved, as well as for the grade of steel to be heated.

Figure 6 — Pit production survey gives data for hourly heating rate vs hearth coverage for 29 x 55 x 69 in. ingots.



The type of pit wherein the flame contacts the ingot does not lend itself favorably to high air preheat because of sharpness of flame, except in the case of low Btu fuels. A sharp high temperature flame tends to wash or burn the steel, especially when the pit is pushed for production.

Pits in which the flame does not contact the ingots are ideally suitable to take advantage of high air preheat, resulting in lower fuel consumption per ton of steel heated, less chance of damage to the steel from washing or burning and, from the writer's observation, an increase in the rate of heating. It is easy to see that while this type of pit is well adapted for heating all ordinary grades of steel, it is particularly well adapted for heating high carbon steel and critical alloy grades.

The center or bottom fired pits and the two-way over-fired pits come under this classification. Both of these designs provide ample combustion space eliminating flame impingement on the ingots. To obtain this condition, not less than 5 ft-0 in. is always allowed between the tops of the ingots and the underside of the pit cover for the two-way over-fired pit.

QUALITY HEATING

Quality heating in a soaking pit usually means bringing the ingots up to rolling temperature in a manner prescribed by the plant metallurgist as being the most beneficial for each particular grade of steel. This includes the avoidance of any undue thermal shock to critical steels and damage by burning from excessive temperatures to all grades.

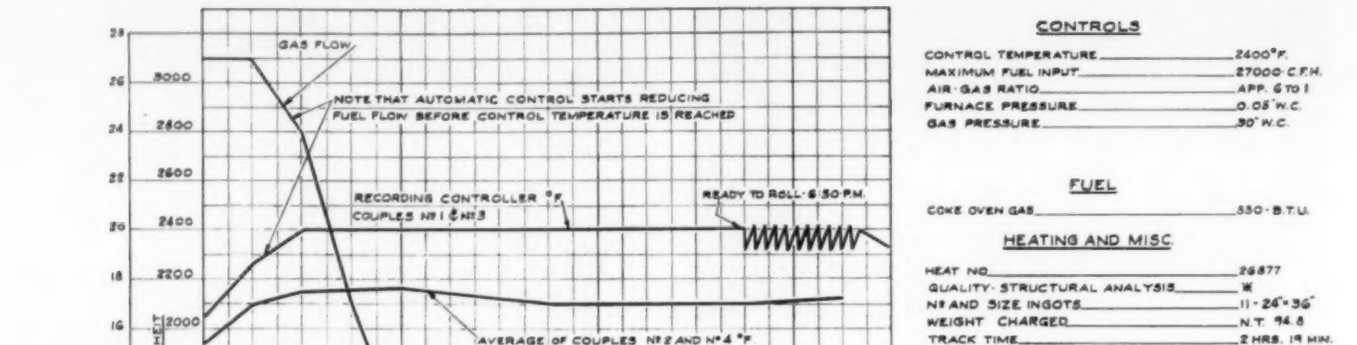
The soaking out period, a very important part of the heating cycle, too frequently is not given sufficient consideration. While it is not always practical to draw steel at the exact moment it is ready, an effort should be made to schedule the operation so as to draw it approximately at the "ready" time. The heater has different ways of telling when a charge is ready to roll; one of the best is the use of the fuel flow chart, the charge being ready when the low fuel flow starts to level out (Figure 7). If steel is held in the pit too long after it is in rollable condition, several detrimental conditions result:

1. An increase in scale loss.
2. An increase in grain growth, requiring more power to roll the steel. There are also other objections from a metallurgical standpoint such as decarburization in some grades of steel.
3. An increase in fuel consumption per ton of steel.
4. A reduction in productivity of the pit.

It is the writer's opinion that there is a period of about 30 minutes after the steel is ready to roll where there is little or no apparent damage done in holding it, but beyond this point the detrimental affects begin to accelerate quite rapidly for certain grades of steel.

PRODUCTION

Quality heating is of necessity usually tied in with the importance of production. It is, fortunately, an


GAS FLOW
NOTE THAT AUTOMATIC CONTROL STARTS REDUCING FUEL FLOW BEFORE CONTROL TEMPERATURE IS REACHED
RECORDING CONTROLLER °F COUPLES Nº 1 & Nº 3
READY TO ROLL 6:50 P.M.
AVERAGE OF COUPLES Nº 2 AND Nº 4 °F
PREHEATED AIR °F
NOTE UNIFORMITY OF AIR TEMPERATURE THROUGHOUT HEAT
AIR FLOW
FUEL FLOW LEVELS OFF INDICATING STEEL IS SATURATED AND READY TO ROLL
WASTE GAS °F AT STACK
AIR FLOW INDICATION PERCENT OF 100%
GAS FLOW IN 1000'S CU FT PER HOUR
ALL TEMPERATURES IN DEGREES FAHRENHEIT
TIME IN HOURS

CONTROLS

CONTROL TEMPERATURE	2400°F.
MAXIMUM FUEL INPUT	27000 C.F.H.
AIR-GAS RATIO	APP. 6 TO 1
FURNACE PRESSURE	0.05" W.C.
GAS PRESSURE	30" W.C.

FUEL

COKE OVEN GAS	550 B.T.U.

HEATING AND MISC.

HEAT NO.	29877
QUALITY-STRUCTURAL ANALYSIS	*
Nº AND SIZE INGOTS	11-24"-36"
WEIGHT CHARGED	N.T. 94.8
TRACK TIME	2 HRS. 19 MIN.
START CHARGING	3:58 P.
FINISH CHARGING	4:08 P.
READY TO ROLL	6:50 P.
READY TO ROLL	2 HRS. 45 MIN.
START DRAWING	7:00 P.
FINISH DRAWING	7:38 P.
TOTAL GAS USED	49,800 CU. FT.
B.T.U. PER TON	287,052
HEATING QUALITY	"A" NO WASHING
SCALE THICKNESS	1/16 TO 3/32

THERMOCOUPLES

Nº 1 AND Nº 3 IN END WALLS 18" DOWN FROM TOP OF CURB. Nº 2 AND Nº 4 IN ROOF OF RESPECTIVE RECUPERATOR CHAMBERS

* C-0.19 MN-0.41 P-0.022 S-0.022 SI-0.037

Figure 7 — Curves represent fuel and air flows together with pit temperature, waste gas, and preheated air temperature, through a representative heating cycle for the pit.

accepted fact that, aside from allowing the required minimum of time for ingots to set as specified by the metallurgical dept prior to moving, quality as well as production is benefited by charging the steel as soon as possible after the ingots are cast.

Therefore, after the combustion and controls have been adjusted for the best possible overall conditions for heating ingots, the greatest possibility for further increasing production from the pits is to make a drive on reducing the track time, that is, the time from finish tap at the open hearth to finish charging in the pit. In this connection it may be necessary to:

1. Offer an incentive to the switching crew.
2. Add another switching engine.
3. Rearrange tracks for more flexibility to facilitate handling of the loaded and empty ingot buggies between the casting platform and the pits.
4. Move the first half of the open hearth to the pits before finish pouring the latter half.
5. Install more pits, if necessary, so as to reduce the percentage of ingots waiting on the track to be charged. Sometimes a lack of empty pits causes a serious bottle-neck, resulting in an increase in track time and an increase in heating time — hence a vicious cycle.
6. Improve the scheduling of different grades or orders of steel, both at the open hearth and mill, primarily to avoid unnecessary holding of steel on the track or in the pits.
7. For an entirely new plant layout, the melt shop should be located as close to the soaking pit building as possible and the ingots stripped close by the pits to avoid unnecessary transportation time and delays.

BOTTOM MAKING

A certain amount of bottom making is unavoidable and is, unfortunately, a necessary evil to soaking pit operation. There was a time when it was generally considered good practice to wash off surface imperfections such as scabs caused by pouring splashes. That time, however, is well on the way out, thanks to modern pits and to automatic controls. Such surface imperfections are considered to be a melt shop problem. Washing steel is not the popular thing to do now even in the older style pits. It is true that some of the low carbon grades of steel such as the so-called "low metalloid" or "ingot iron" grades, require rather high temperatures in order to obtain the best rolled product and under these conditions it is difficult to avoid some washing of the scale and resulting bad bottom conditions.

Another contributing factor to bad bottom conditions is the refractory hot tops where these are used. Cleaning this refractory material off the tops of the ingots offers a problem that should be solved because some of it not only drops off into the pit bottom, but any remaining lowers the fusion point of the scale causing a certain amount of washing.

Plants which have neither of these problems to any great extent, or do not ordinarily wash their steel, may find it to their advantage to use the so-called "dry" or cokeless bottom method. In the past six years, several steel companies have adopted this method. Briefly, it consists of using no coke but spreading two or three inches of ground magnesite or some such material on the brick hearth before charging the first ingots to act as a parting material, and then allowing the scale and slag accumulations to be built up to an approximate

depth of 12 in. and then digging it out with air jack hammers. The bottom making periods are thus extended to as much as five to eight months. It is claimed to be much more economical, not only in the saving of coke and labor, but also in keeping the furnace in production a greater percentage of the time.

MAINTENANCE

Good housekeeping, good maintenance and good operation—these three seem to go hand in hand. If the first two are insisted upon by the management, the third always seems to follow more naturally. Keeping the area cleaned up and orderly, and maintaining not only the pit proper, but also the burners and controls, in tip-top condition at all times, help very materially in obtaining maximum efficiency resulting in quality heating and maximum production. It pays dividends to take care of small repairs as quickly as possible and not limp along, delay, or postpone making them until they become major repairs requiring large expenditures—to say nothing of the most expensive cost of all—loss of production. If a curb block gets knocked off or a brick drops out of the cover—even the best of them do not last indefinitely—it should be repaired before the pit is charged again to avoid additional damage to the cover seals or beams by the intense furnace heat. Maintenance of burners, pit bottoms and controls all come in the same category. It is usually part of the heater's job to report such things and see that they are promptly repaired. The old saying "a stitch in time saves nine" is strictly up to date.

Also, it is best to foresee maintenance trouble and prevent it rather than just let things happen. For example, the heater should see and remove objects like scale, hot top refractories, spalled brick, slag, or anything that drops or may build up on top of the curb after drawing ingots, and which may project enough to force brick out of the covers. Also, the fuel department should systematically check certain parts periodically to avoid failure, such as couples, burners, furnace pressure taps, controls and meters.

PERSONNEL

Both the heater and the ingot craneman are key men in operating a soaking pit installation. While the heater is really in charge of and operates the pits, the ingot craneman can do more to aid or impede successful operation than any other individual in the plant.

The ingot craneman is in a position to do a "sloppy" job of charging the ingots so that 25 to 30 per cent more time is required to heat a charge due to improper spacing of the ingots. He can drag his tongs or the ingots up or down the wall, tearing up the wall and coping, or he can fail to report promptly when the walls or some other part of the pit has been damaged and need attention.

Without the cooperation of the ingot craneman, the heater is greatly handicapped and cannot do his work successfully. Ingot craneman, as a rule, however, usually have a desire to do their job and with the proper attitude on the heater's part they can do good work together.

As a result of having placed a large number of soaking pits in operation over the past 15 years, the writer has found the practice invaluable of getting all the heaters and pit cranemen together, along with representatives of the fuel department, and going over the problems and requirements of successful pit operations and maintenance so as to get off on the right foot from the start.

The heater, having thousands of dollars worth of steel under his care, must be on the alert at all times to see that not only all of his equipment is functioning properly, but to watch the steel as it is charged into the pit to make sure it is set or spaced properly and, in accordance with the best practice. He should also watch it drawn to see that it is in proper rolling condition or to see where improvements may be made in one way or another. Once during his turn he should make an inspection trip around and from top to bottom of his pits to see if everything is in order.

The heater cannot take things easy and expect the automatic controls to do his work. If he does, then he is the type of man who wakes up sooner or later to find a charge melted down in a molten mass in the bottom of a pit. He cannot leave the charging and drawing of ingots entirely to the ingot craneman, neither can he leave the bottom making entirely up to the bottom makers. His job consists of direct supervision.

It is the writer's opinion that the best results are obtained from trained and experienced heaters who know steels. For a reasonably large pit installation, a heater foreman may easily be justified. His duty should be to coordinate all three turns and be directly responsible to the mill superintendent for the entire ingot heating operation. It is bad practice to allow each heater to operate the pits according to his own wishes; there should be some centralized control. If there is no heater foreman, then the mill superintendent or his assistant should be the boss and be capable of setting up certain rules and insist that all heaters conform. A certain amount of flexibility must, of course, be allowed for taking care of special conditions.

Since the maintenance of all combustion equipment, including the automatic controls and meters, come under a branch of the fuel department, it is up to that department to keep the equipment in first class operating condition at all times. The heater has all he can do to operate without trying to repair or adjust equipment, and he should not be expected to work with equipment out of order.

The metallurgical department, being primarily responsible for all temperature requirements and limitations for the steel to be heated, should make up a tabulation listing temperature settings for the various grades of steel along with other specific instructions and post a copy in each control house so there may be no misunderstanding by the heater.

Since the ingot craneman, as previously stated, seems to be the most important man next to the heater in connection with the successful operation of the soaking pits, it seems only logical that he should come under the direct supervision of the mill superintendent instead of under some other person, as is too often the case. In two plants, to the writer's knowledge, the ingot cranemen are not only members of the mill superintendent's personnel, but as an incentive to obtaining their best

cooperation in operating the furnaces, they are promoted into the heater's ranks when vacancies occur. This idea has worked out so successfully in these two plants that it can be recommended without hesitation.

SUMMARY

In conclusion, one must first have a good pit furnace and it must be the correct size for the particular plant. Whether it should be large or small depends on the requirements and economics of the plant.

A proven recuperator is the most economical means of heat recovery providing the design of the pit is such that the resulting high temperature flame does not impinge on the surface of the steel. It naturally follows that such a design is particularly adaptable for heating high carbon and alloy steels.

Automatic control equipment is an essential tool for best pit operation.

The quality of heating is materially affected by the length of the soaking period. It should be as short as rolling requirements will permit.

Quality, as well as production, is benefited by the shortest obtainable track time above the minimum required for metallurgical reasons.

As to bottom making, the amount of washing done, the percentage of refractory hot tops used and, the amount of "low metalloid" steel or "ingot iron" heated in a plant determine the advisability of adopting the more economical "dry bottom" method, as compared with the coke bottom method.

Good maintenance is essential to good pit operation. Promptly taking care of minor repairs also reduces the number of expensive major repairs and the accompanying loss of production.

The heater and the ingot craneman are the key operating men and both should be members of the mill superintendent's personnel. As an incentive for the best cooperation from the ingot craneman, he should be in direct line for promotion to the heater's ranks.

DISCUSSION

PRESENTED BY

D. BAKER, Combustion Engineer, Timken Roller Bearing Co., Steel and Tube Div., Canton, Ohio.

F. H. GRAHAM, Chief Operating Engineer, Amsler-Morton Corp., Pittsburgh, Pa.

D. Baker: There is one question on automatic controls and the quality of heating I would like to ask. Instrument manufacturers claim that "on-and-off" control with natural gas firing gives better heating. It fills a pit with gases, and you get better distribution and heat. I would like to hear of any experience and comments on that.

F. H. Graham: We have tried "on-and-off" control on three installations of our center fired pit, one particularly where the pit was a little off size. It was a very long pit, and narrow, and while we obtained fair results with the modulated control, we did get excellent results with the "on-and-off" control. We then tried the "on-and-off" control on a couple of other jobs of standard pit dimensions and we found no advantage. We went back to the modulated type of control. I think it depends on the type of pit you have as to which is the better type of control.

Member: I would like to have Mr. Graham comment on the optimum quantity of excess oxygen contained in your pits for best heating and rolling purposes?

F. H. Graham: As to the optimum amount of oxygen, I think that depends on a good many things, and on the type of steel you are heating. Sometimes it is best to have a good deal of excess air in order to obtain faster heating. If you heat the steel up fast and get it out quickly, a relatively large amount of oxygen has little or no detrimental effect. In this case the scale thickness is really less than if you left the steel in with a low percentage of oxygen for a long period of time.

There are three things that determine the thickness of scale: the temperature, the time at temperature, and the amount of oxygen present. The amount of oxygen, of course, is the lesser of the three.

It also depends on the type of steel being heated. There are many other things that come in to the picture such as decarbonization.

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ASSOCIATION OF IRON AND STEEL ENGINEERS, 1010 EMPIRE BLDG., PITTSBURGH 22, PA.

A METHOD FOR HANDLING STEELMAKING SLAG

. . . . developed at Consett Iron Works, County Durham, England, and originally intended to improve the handling of flushing slag, the granulation of steelmaking slag promises a definite contribution to the economy of the steel industry . . . . the granulated product is sintered and used as blast furnace charge material . . . .

▲ WITH the decline in scrap supplies and the need for charging a higher percentage of pig iron, either hot metal or cold pig, the quantity of slag made during the working of a charge becomes increasingly difficult. At Consett Iron Works in England, this was emphasized by the fact that the melting shop, which was rebuilt in the early '20's, does not have furnaces equipped with a railway beneath the slag arch of the furnaces for expeditious placing of a slag ladle under the middle charging door. Also it should be explained that the melting shop was, prior to 1945, composed of 75-ton units which have been doubled in capacity to 150-ton without any structural alterations to the columns or overhead crane supports. As the percentage of iron in the charge increased, slag accumulated below the charging floor in such proportions that the plant was faced with the necessity of taking a furnace off after 11 or 12 weeks to remove the accumulated slag, despite labor constantly employed for this purpose. It will be appreciated that such work would be constantly interrupted due to the risk attendant on such an occupation when slag might be discharged over the middle door breast at any time late in the charging or during refining.

In an effort to find a better way to handle slag, a number of experiments were made (using a slag ladle which unfortunately could accommodate only 85-90 cu ft of water), toward granulating the slag. The conclusion was reached that granulation was possible provided the tank to be employed would hold a sufficient volume of water and that a new supply of water could be admitted to the tank during "slagging-off" operations. It was also realized that, due to the limitation of supply at Consett works, sufficient water would not be available to maintain a temperature below boiling point, so that a steam hood and an extraction fan would be essential to maintain normal working conditions for the furnace crews on the charging floor.

The initial installation (Figure 1) was made on a 150-ton basic furnace and went into operation in February, 1951. The results encouraged further experimenting which has been most gratifying. If, track access were available to the furnace, the arrangement shown in Figure 2 would, of course, be preferable.

It was obvious from the analysis and the nature of the flushing slags (Table I) that it would be ideal for sintering, and with an approximate average Fe content of 15 per cent, together with the CaO and MnO, a commodity was available which could be used to excellent purpose. With this in mind, granulation became more than a means of convenient handling and indicated that the same line of thought must move to the casting bay to provide more slag for sintering purposes. This has now been done. The original installation is shown in Figure 3, with an alternate arrangement sketched in Figure 4. Experiments at the sintering plant show that an excellent grade of sinter can be made from flue dust, granulated open hearth slag and returned fines, and the operators have so far used up to the proportions of 40.1, 40 and 13.4 per cent respectively, with the addition of 6.5 per cent of coke breeze. High percentages of slag have been used deliberately over a number of experiments to give some indication of what is possible when sufficient quantity of slag will be available to use in such proportions, and it is anticipated that, within a few months, the usual percentage of granulated slag to be included in the sintering mixture will be 30-34 per cent. Sinter analyses, together with the proportions in the mixture and the relevant screen tests, are shown in Table II, while Table III gives data on another sample which will be called No. 12. This sample was made by substituting rougher screened out slag in place of rougher screened out iron ore for "bedding."

Although these experiments are so far associated with a fixed basic open hearth furnace, similar methods can be employed in all steelmaking practices, either acid or basic, fixed or tilting furnaces, or bessemer converter operation.

TABLE I

GRANULATED BASIC OPEN HEARTH SLAG

(Basic iron analyses percentage range: Si 0.70/1.00; S 0.05/0.09; P 1.00/1.40; Mn 0.80/1.0)

Range of analyses—flushing slags, per cent	
Fe	11.2 — 33.40
SiO_2	10.9 — 20.90
Al_2O_3	2.6 — 2.93
CaO	21.0 — 53.20
MnO	5.2 — 10.42
MgO	4.36 — 6.48
P_2O_5	3.60 — 14.00
Citric solubility	35.20 — 98.20
Sol. P_2O_5	3.80 — 13.75
S	0.091 — 0.45
Theoretical slag volume per ton of steel ingot (2240 lb)	
Hot metal, per cent 30 / Scrap, per cent 70	409 lb
Hot metal, per cent 80 / Scrap, per cent 20	611 lb
Grading test, per cent	
Over 1 in.	0.3
1—½ in.	0.8
½—¼ in.	3.2
¼—⅛ in.	26.3
⅛—1/16 in.	36.7
Under 1/16 in.	32.7
	100.0

Note: The granulated slag weighs about 106 lb per cu ft.

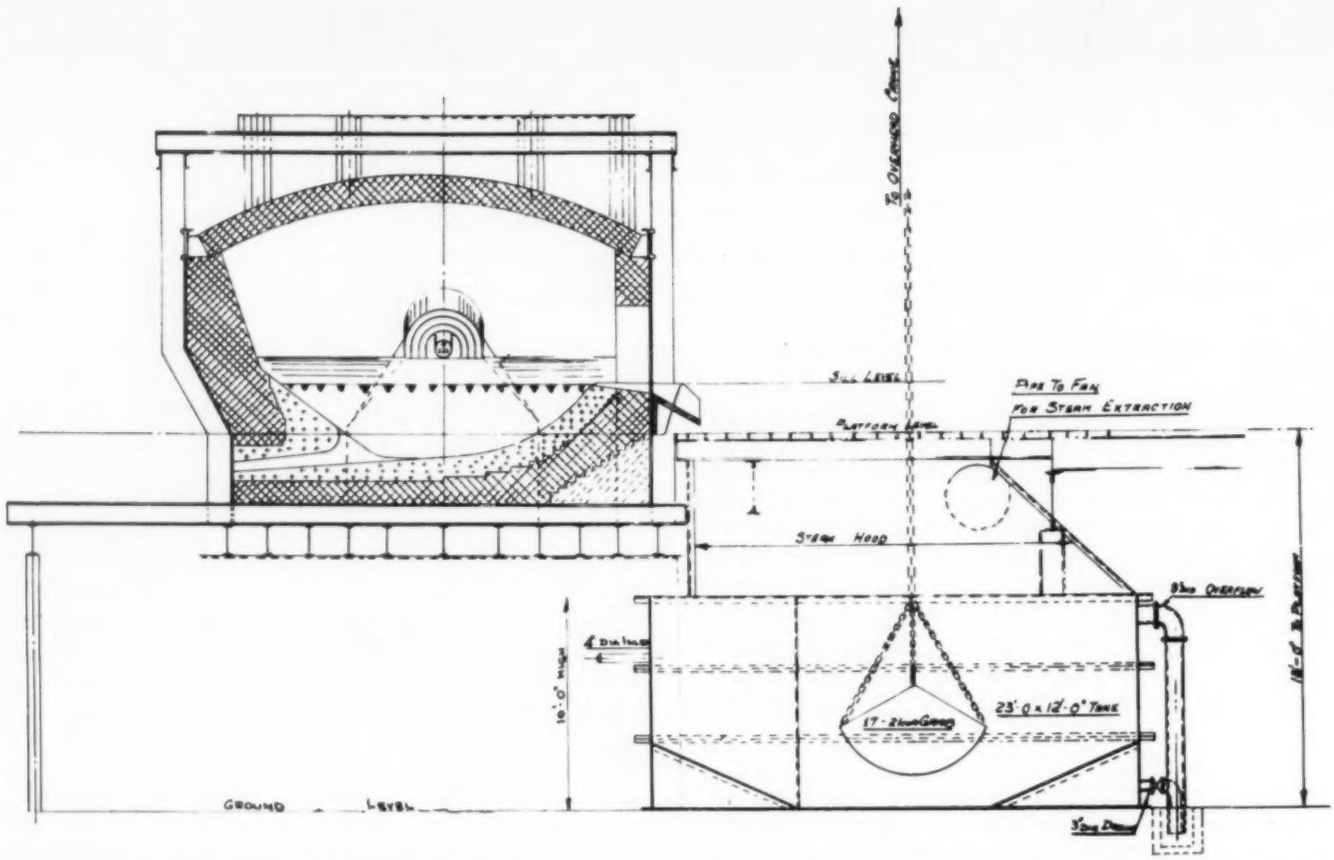


Figure 1 — The flushing off arrangement which has been adopted at Consett because of the shop layout is shown. A section of the floor is lifted and the slag removed from the tank by a grab hung from the auxiliary hoist of the charging machine. The tank is fitted with a steam hood and an extraction fan for steam removal when the granulating water reaches boiling point. If sufficient water were available to allow an 8-in. pressure inlet, it is probable that the hood would not be required.

Figure 2 — The ideal type of tank equipment for a furnace provided with rail access, and to be used during slagging-off over the middle door breast. The mobile tank is equipped with trunnions, water inlet, tilting ring, drain hole and pouring lip. This equipment would be very appropriate for initial slagging-off operations when the P_2O_5 in the slag can be expected to be reasonably high, the tank being withdrawn and tipped expeditiously and replaced either at the same furnace or another one in the shop.

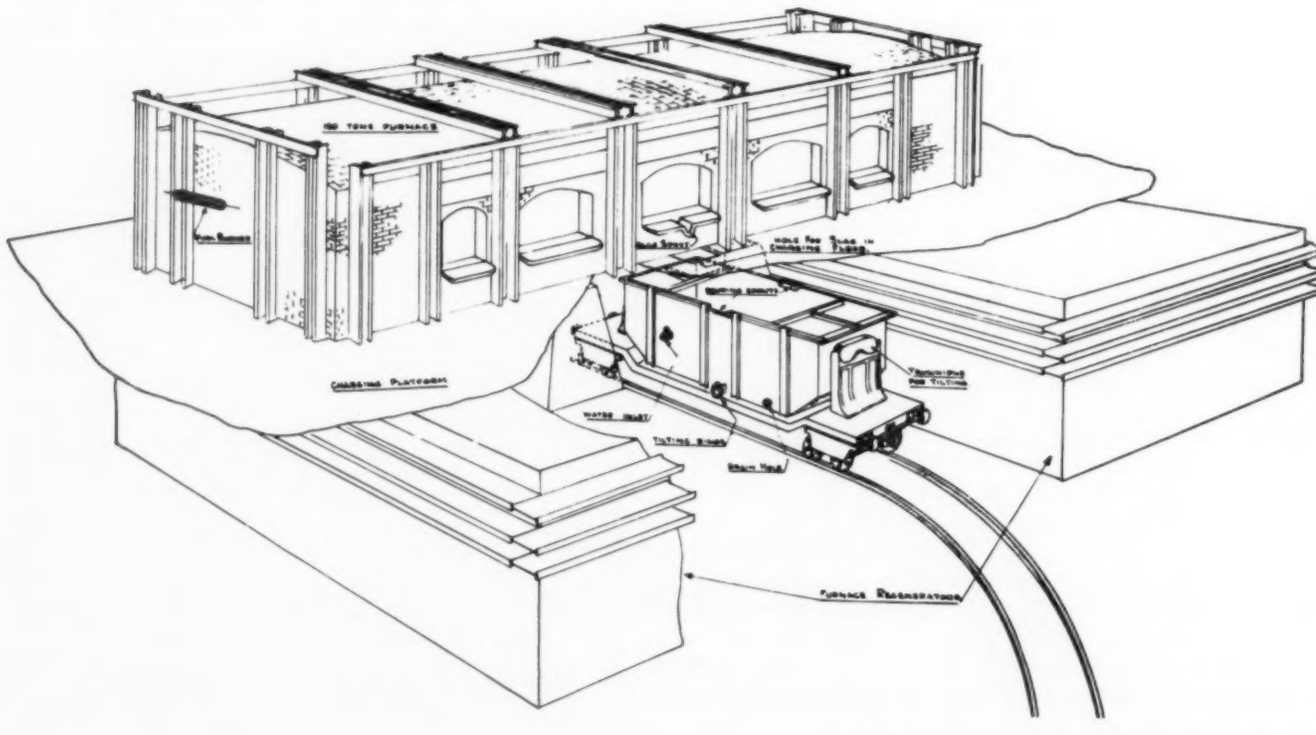


TABLE II

SINTER DATA

PERCENTAGES OF RAW MATERIAL, ANALYSES AND SCREEN TESTS

	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11
Mixture											
Granulated slag	12.9	28.8	38.8	40.1	17.0	23.0	27.0	14.7	26.0	37.3	37.1
Screened ore	62.4	.....	.....	40.0	58.0	53.7	51.2	55.1	44.6	.....	.....
Returned fines	12.9	14.3	17.9	13.4	10.6	10.1	9.4	12.9	13.0	18.6	18.9
Flue dust	5.5	53.4	38.8	.....	9.2	8.0	7.2	11.0	11.2	37.3	37.1
Breeze	6.3	3.5	4.5	6.5	5.2	5.2	5.2	6.3	5.2	6.8	6.9
Analysis of sinter											
Iron	57.06	56.37	50.79	50.29	56.54	55.57	53.77	56.47	55.85	53.16	53.81
Ferrous oxide	22.89	21.69	27.89	19.80	14.59	14.39	14.39	14.89	20.61	25.08	24.60
Silica	8.35	8.20	8.80	8.00	6.40	6.99	7.50	6.60	7.20	8.99	7.95
Lime	2.60	5.00	11.40	12.40	5.70	6.90	7.90	7.10	7.40	5.20	6.23
Phosphorus	0.266	0.64	1.10	1.29	0.710	0.774	0.918	0.890	0.68	0.959	1.11
Manganese	1.38	1.02	1.69	1.72	1.24	1.46	1.57	1.50	0.82	1.45	1.44
Sulphur	0.027	0.027	0.151	0.11	.....	.....	.....	0.015	.....	0.032	0.047
Alumina	6.27	5.64	2.59	3.76	.....	.....	.....	2.70	.....	5.52	.....
Magnesia	0.72	1.70	2.17	1.91	.....	.....	.....	1.59	.....	.....	.....
Moisture	0.06 (Air cooled)	0.05 (Air cooled)	0.02 (Water quenched)	0.02 (Water quenched)	0.10 (Water quenched)	0.06 (Water quenched)	0.05 (Water quenched)	0.05 (Water quenched)	0.10 (Water quenched)	0.08 (Water quenched)	0.02 (Water quenched)
Screen tests											
Over 3 in.			26.9	37.3	18.9	19.5	17.9	25.3	31.9	18.5	16.8
3—2 in.			16.0	15.5	12.4	10.9	16.1	23.8	13.1	19.9	13.5
2—1 in.			17.0	14.4	12.5	15.1	9.6	11.6	17.8	15.2	12.7
1—½ in.	Not	Not	22.2	16.5	22.5	24.1	19.7	19.7	21.1	19.6	16.1
½—¼ in.	done	done	13.6	12.3	26.5	23.3	25.6	10.7	7.1	19.9	25.6
¼—⅛ in.			2.8	2.5	4.8	5.6	8.0	6.6	6.8	5.0	11.9
Under ⅛ in.			1.5	1.5	2.4	1.5	3.1	2.3	2.2	1.9	3.4

It should be mentioned that the sinter handling at Consett subjects the material to very rough treatment by using a skip to a tower, followed by the water quenching. Attention is drawn to Sample No. 11 which was done with a sintering time reduction of 20 per cent and indicates that, with improved fan operation, a reasonable increase in sinter output can be expected, which will bring the two smallest sizes of the screen tests in line with the other 10 samples; although the sintering was complete the temperature of the material was appreciably higher which accounted for the additional fracture.

TABLE III

SAMPLE NO. 12

Composition of mixture	
	Per cent
Granulated slag	32
Flue dust	11
Screened ore	38
Returned fines	13
Breeze	6
Analysis of granulated slag	
	Per cent
Silica	22.1
Lime	26.2
Phosphoric acid (P_2O_5)	8.1
Iron	18.4
Manganous oxide	8.8
Analysis of sinter	
	Per cent
Iron	52.87
Ferrous oxide	12.59
Silica	9.60
Manganese	2.18
Alumina	6.60
Lime	5.50
Phosphorus	0.597
Sulphur	0.033
Magnesia	1.20
Moisture	0.05
Screen tests	
	Per cent
Over 3 in.	17.6
3—2 in.	16.4
2—1 in.	14.5
1—½ in.	17.3
½—¼ in.	24.2
¼—⅛ in.	7.5
Under ⅛ in.	2.5

The advantages of this development are obvious to the experienced operator, and if we take a conservative allowance per unit of Fe, the subsequent credit from the sintering department to the melting shop is substantial without taking into consideration the value of CaO and MnO in the slag when charged into the blast furnace. Indeed, it may be many months before the full advantages can be closely estimated. By sintering the slag before charging, the product is far superior to the raw slag and there are indications that it is more easily reduced in the furnace, with the consequent improvement in blast furnace pressure.

What may be regarded as a disadvantage can be turned to profit when considering the P_2O_5 in the granulated slag, by arranging for the slag to be removed from the tank—or, as shown in Figure 2, the tank ladle car—before the addition of fluor spar for working the charge, and the slag ground from its granular state to whatever size is required for sale as a fertilizer.

A number of experiments show that the lowering of citric solubility by the addition of fluor spar is by no means as serious as when associated with the slag ball, as the solubility is doubled when the slag is granulated from the high working temperatures.

If a conservative 12,000,000 tons per annum is assumed of steel ingots from all basic processes in Great Britain, on an average basis of 65 per cent metal and 35 per cent scrap, there is a probable slag tonnage of 3,000,000 tons which, at 14 per cent Fe value, indicates a possible 430,000 tons of Fe, and if 20 per cent of that

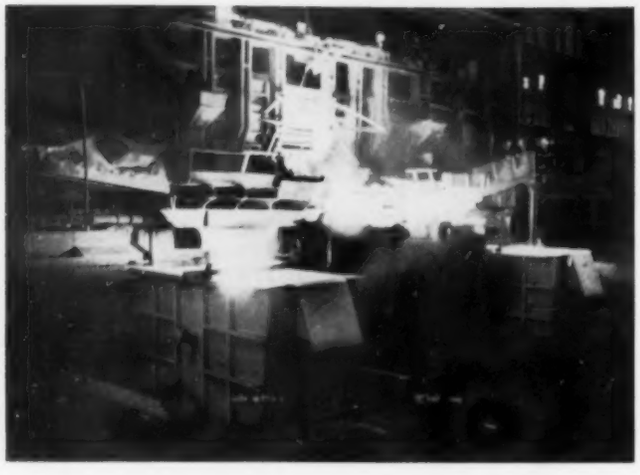


Figure 3 — Showing tapping and slag overflowing into the granulating tank on the tapping side.

Figure 5 — Close-up of tundish showing overflow spout from steel ladle, centre hole and overflow spout from tundish to tank.

was segregated because of its P_2O_5 value for resale for fertilizing purposes, there is still left more than 300,000 tons of Fe annually which could be put to better purpose than that for which it is now being used.

Experience to date indicates that the granulating tank will have a period of service life far in excess of a slag ladle. Also there is reduction in locomotive traffic. The operators are not unduly concerned with steel overflow as they have already had some experience in this line. If the quantity is small on the front side of the furnace, it goes into nodules in the tank and remains unnoticed; a larger quantity which was associated with a breast break-out was lifted out of the tank as "skull" to a total amount of 10,760 lb, one piece of which was 8100 lb and the balance made up of smaller pieces.

With the equipment installed as shown in Figure 3,

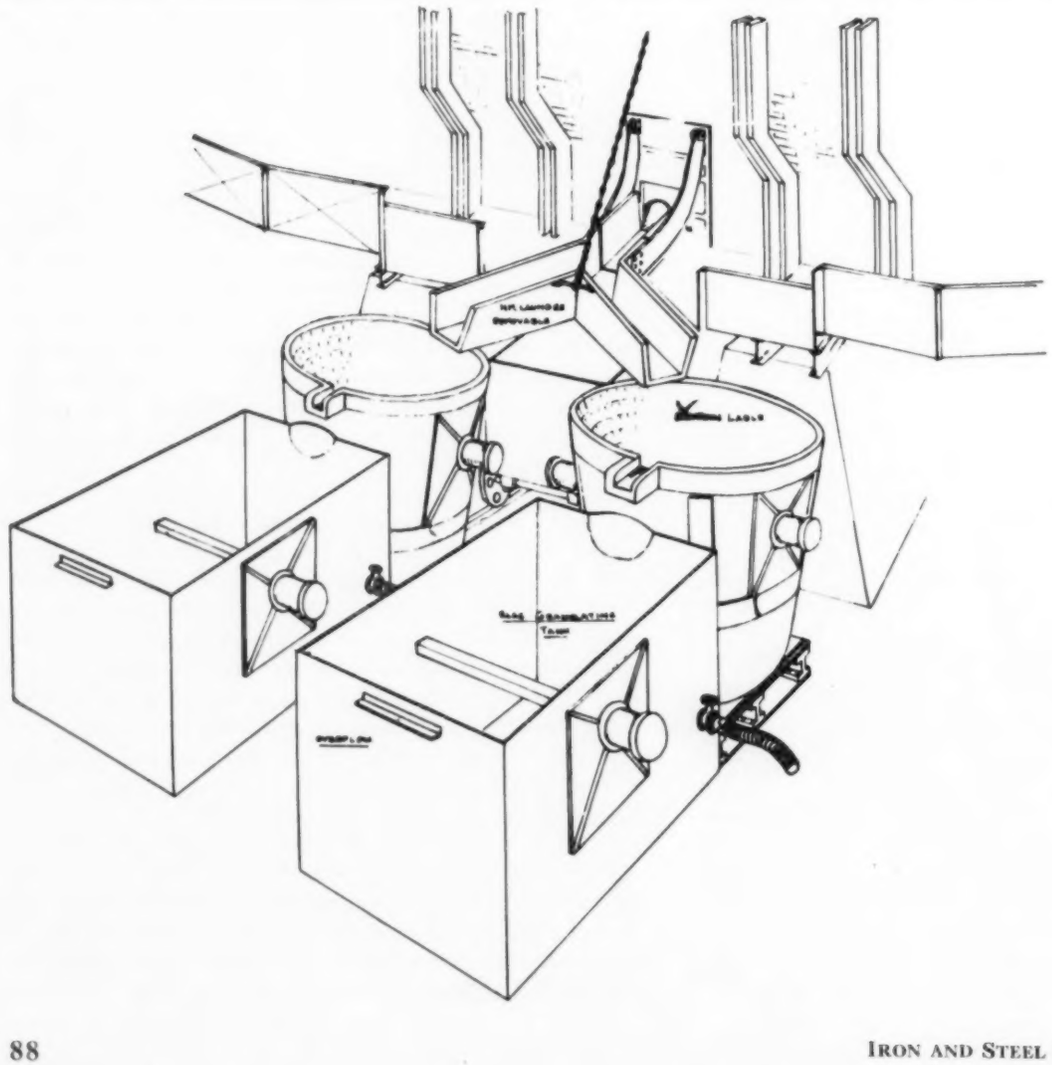


Figure 4 — Isometric sketch of a casting bay, showing a furnace equipped with a bifurcated tapping spout, suitable where space does not permit the arrangement shown in Figure 3.

Figure 6 — Tanks and tundishes in position prior to tapping.

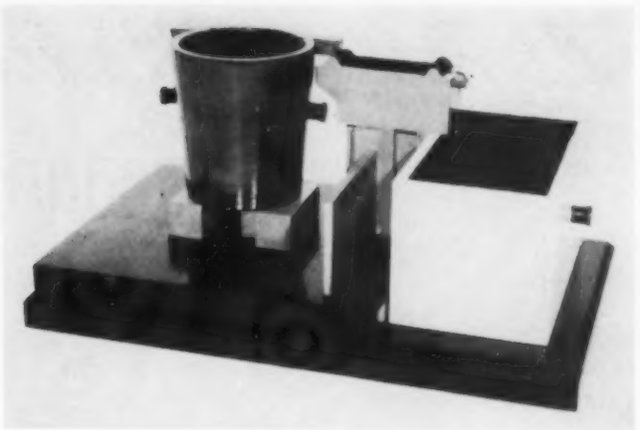


Figure 7 — Arrangement of model shows the new tundish mounted on a brick pier, with brick dividing wall between steel ladle and granulating tank.

it appeared that nothing further was to be done except to keep tapping furnaces and granulating slag, until an eroded taphole coincided with a big charge which also had an extra heavy slag accumulation. Then, of course, there was an exceedingly rapid fill-up of the steel ladle, coupled with an equally heavy overflow of slag, which amounted to more than 20 tons in each tank on the final check-up. This sudden overflow and immersion was so rapid that a particularly heavy boil resulted in the tank, with clouds of steam. To rectify this, it was impossible to control the size of the tapping hole; therefore the flow had to be controlled in its introduction to the water. A tundish, or a variation thereof, seemed to be the answer. Tundishes were improvised from top sections of blast furnace slag ladles, plated on the bottom, with a central hole and a bottom lining of brickwork put in to protect the plating, until such time that the foundry could cast a similar section with a bottom and central hole in one piece. As only actual practice could prove what size hole would best serve the purpose in the bottom of the tundish, an extra provision was made for an overflow by cutting a section of the rim and attaching to it a cast iron spout. As the theoretical capacity of the tundish was approximately seven tons, it was fairly safe to assume that, with a 5 in. square hole, it would be very unlikely that sufficient depth would build up in the tundish to come over the overflow while the hole was still functioning and the slag running freely. The tundishes were installed on top of the granulating tanks as shown in Figures 5 and 6. This has eliminated the clouds of steam which could arise without this innovation.

The arrangement described worked exceptionally well until, through carelessness, a tundish which had to be rebricked at short notice was put into service without proper drying. The result was that after 3 to 3½ minutes—when the depth of slag in the tundish was about 20 in. and equal to roughly 3½ tons—the bottom blew up, lifted the tundish at an angle of 45 degrees and dumped the whole contents of slag into the tank, which resulted in the inevitable explosion. To remove this hazard, a new cast iron tundish has been designed, eliminating the refractory lining, as shown in Figure 7.

All of the furnaces at Consett works have been provided with the equipment for slag granulation.

POTENTIAL VALUE TO USA PRACTICE

Fairly recent quotations show the price of high phosphorus Lake Superior ore at $8.30 at lower Lake ports, which probably indicates $9-$10 at consuming points; so on a conservative basis of 12-14 per cent Fe content of the granulated slag, the value of its iron content alone is in the neighborhood of $2.50. To this can be added the lime and manganese, the latter being of particular significance when it is remembered, from quotations last seen, that the freight alone of manganese ore to U. S. ports is $16-$17 per ton.

If we use the figure of 93,000,000 net tons of ingots as the U. S. production for 1950, it is fairly safe to assume that 80,000,000 tons were made by some basic practice, which indicates, at 500 lb per ton of steel, 20,000,000 tons of slag, equal to about 2,500,000 tons of Fe, roughly 6,000,000-7,000,000 tons of lime and 1,000,000 tons of manganese. The metallurgical value of the granulated slag is now assessed conservatively at $2.50 per ton, and there are other considerations which should be taken into account, such as the price of slag ladles, rolling stock equipment for ladles and the necessary locomotive power for this type of traffic.

Recent reports about taconite pellets to be made by the Reserve Mining Company at Beaver Bay in Minnesota show a required cost of $70,000,000. The plant is rated at 2,500,000 tons annually. This tonnage is being wasted every year and can be recovered by granulating the slag at a purely nominal cost. The material so made is not only valuable for its metallurgical composition, but present practice proves conclusively that the sintering operation is greatly improved, the burden being "opened-up." It is fairly certain that sintering time can be reduced by about 20 per cent.

It should be noted that the granulated slag was screened out and the rougher material was used for bedding on this particular batch. The results were highly satisfactory and indicate that this could be adopted as regular practice, so that the rough ore, which has normally been used for bedding purposes, can go to the furnaces.

Limiting Maximum Overload

ON WOUND ROTOR INDUCTION MOTOR

J. W. DEIMLER
Assistant Superintendent, Maintenance
Alan Wood Steel Co.
Conshohocken, Pa.

. . . . an ingenious expedient was used to get all the available capacity out of a drive motor when mill capacity was increased . . . .

▲ The conversion of our 18 × 32 × 56 in. three-high sheet mill, to a 28 × 32 × 72 in. mill, to roll our diamond floor plate pattern, presented many problems. The limitations of the driving unit, a 600-hp, 2300-v, 25-cycle wound rotor motor, was only a part of the whole change-over, including foundations, re-heating furnace, and mill tables. This paper, however, deals only with the motor problem.

Early in the consideration of the conversion, the question arose as to what would be the maximum plate length, which could be rolled when making a single pass to form the diamond pattern, with the existing motor. The sales department was very anxious to get at least a 64 × 144-in. sheared sheet. The sheets to be rolled, were to be reduced to the required gage in a "breakdown" mill, then re-heated to an average rolling temperature of 1700 F, and passed through the mill. In the case of the 64 × 144-in. sheet, it was to be reduced from 0.215 to 0.125 in., with 35 per cent of the area raised 0.06 in. to form the diamond. This represented the most severe load condition which would have to be met.

One method of determining the required horsepower to make a given reduction on a sheet of steel, is based on the following three factors:

1. Cubic inches of metal displaced, or the difference in cross-sectional area, times the length of the sheet.
2. Energy required to displace one cubic inch of metal at the temperature and hardness existing during the pass. From a manufacturer's actual test data, a factor of 12 horsepower-seconds per cubic inch for smooth plate, was used. This was increased 33 per cent to 16, to allow for the additional energy required to form the diamond pattern, based on our experiences on other mills.
3. The actual time required for the pass.

Using these factors, and using a 64 × 144-in. plate, we arrived at a close approximation of the horsepower required by using the formula,

$$HP = \frac{\text{Cubic inches displaced} \times 16}{\text{Pass time in seconds}}$$

So, in the case of the 64-in. wide plate, we have the following conditions:

Area before pass —0.215 × 64	13.75 sq in.
Area after pass —0.125 × 64 = 8.0	
0.06 × 64 × 35 per cent = 1.35	
	9.35 sq in.
Difference in area	4.4 sq in.

Which gives a 32 per cent reduction.

Volume displaced = (144 × 68 per cent) × 4.4 = 431 cu in. With a mill speed of 30 rpm, and 28-in. diam rolls, the pass time for a 144-in. plate is:

$$\frac{144}{60 \times 30 \times 28 \times \pi} = 6.2 \text{ sec}$$

The horsepower required, therefore is:

$$\frac{431 \times 16}{6.2} = 1110 \text{ hp}$$

$$\text{plus } \frac{100 \text{ hp (friction)}}{1210 \text{ hp}}$$

Actually, only at the start of the pass, is the mill speed 44 in./sec since the mill gradually slows down, due to loss of stored energy in the flywheel, and the slip of the motor.

Several types of control are available for this application, namely: fixed secondary resistance, secondary notch-back control, and secondary slip regulator. With a fixed total secondary resistance, the input to the motor rises, and the speed decreases as the length of the plate increases. By use of the formula, points on curves of hp, and plate length, can be plotted as shown in Figure 1. It will be noted that approximately a 150-in. plate

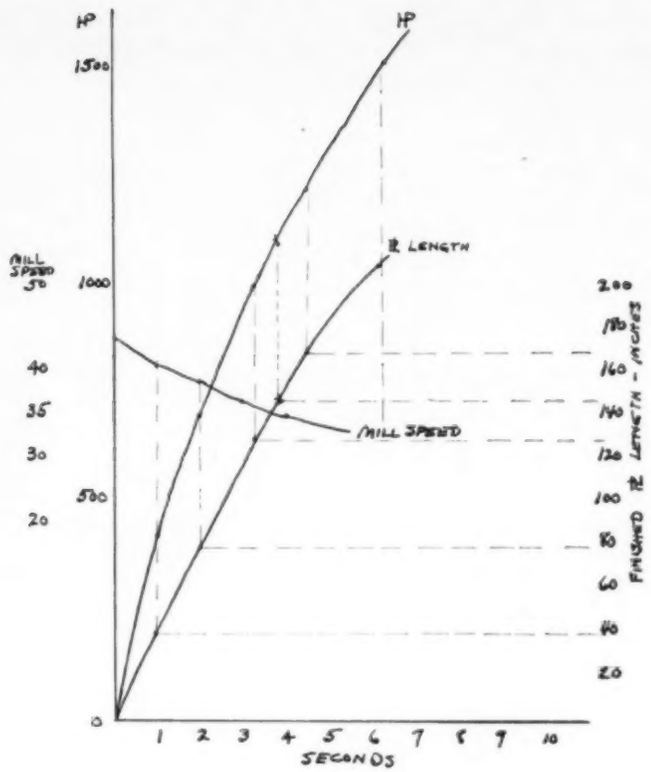
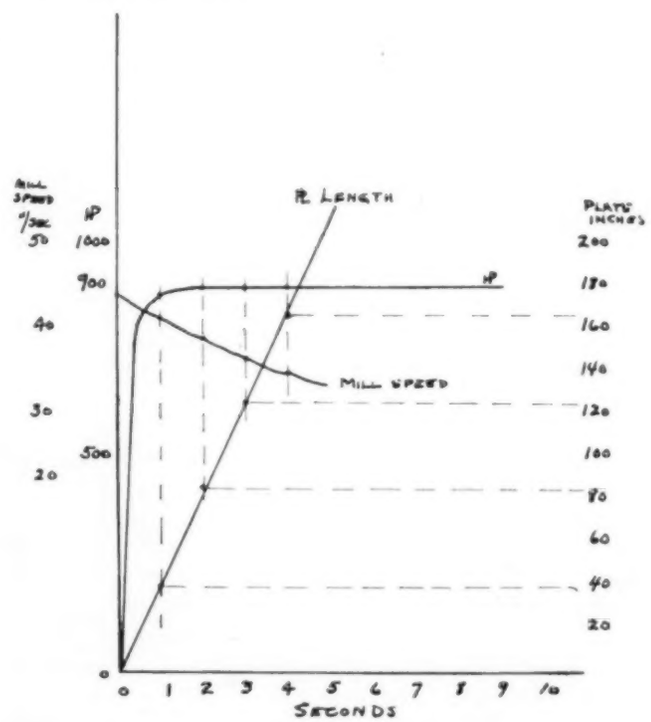


Figure 1 — Curve shows that maximum length of plate which can be rolled is about 120 in.

could be rolled before the drop in speed would exceed 0 per cent or 35 rpm. However, with this length, the maximum recommended safe overload of 900 hp on the motor is exceeded. The maximum length that should be rolled, is about 120 in. The notch-back control would improve this condition slightly, but this type of control has not been too satisfactory, and was not recommended.

Figure 2 — The slip regulator limits the horsepower to the desired maximum.



The maximum conditions can be obtained by the use of a slip regulator in the motor secondary. The regulator will allow the input to the motor to rise practically instantly after the start of the pass, and then limit the load to the desired maximum. Figure 2 shows the same curves as in Figure 1, plotted for these conditions. It can be seen from the curves, that a 170-in. plate could be rolled before the limiting conditions of speed drop are exceeded. Therefore, a slip regulator set to limit the motor load to 900 hp, gives the most satisfactory means of obtaining the required operation.

The liquid slip regulator actually serves a dual purpose in this installation, since it also serves as the starting control. It can also be used as an automatic controller for wound rotor motor drives with a flywheel on the motor shaft. The flywheel can be made to give up additional energy on a peak load, and absorb energy on the light load cycle, thereby "smoothing-out" the peak load points.

The slip regulator is also being more frequently used as a variable step-less speed controlling device for large slip ring motors.

The operation of the liquid slip regulator in this installation, is relatively simple. Three stationary, and three moving electrodes, are contained in a tank filled with an electrolyte solution (sal soda or soda ash). The three moving electrodes are suspended from a common counter-weighted cross-beam, which is supported from arms on the ends of a torque motor shaft. The torque motor is a single wound-rotor induction motor.

The sequence of operation is briefly as follows:
At start-up, the regulator is latched, so that the electrodes are in the fully open position. When the primary circuit breaker of the main motor is closed, the regulator is unlatched and series current transformers in the main motor primary circuit, supply energy to the torque motor, causing it to hold the electrodes in the full open position. As the starting current in the main motor decreases, the moving electrodes move toward the stationary electrodes, thus reducing the resistance in the main motor secondary circuit, until an equilibrium point is reached.

If a heavy load is applied to the motor, the primary current is increased, and the torque motor will cause the electrodes to separate sufficiently to re-establish electrical equilibrium. If the load on the motor continues to increase, the electrodes will continue to open, until the fully open position is reached. In the case of our installation, this fully open position has been designed and set for a maximum overload of 900 hp, or 150 per cent full load on the main motor.

When the main motor is tripped off the line, an auxiliary circuit causes the torque motor to raise the electrodes to the fully open position, and re-latch the regulator in the start-up position.

The drive motor in this installation is unquestionably hard pressed to meet the maximum requirements, but on shorter lengths or narrower widths, there is a comfortable margin. The limitations previously mentioned, have become quite apparent, from actual rolling experience.

DISCUSSION

PRESENTED BY

H. H. ANGEL, Electrical Engineer, Construction & Engineering Dept., Bethlehem Steel Co., Bethlehem, Pa.

M. B. ANTRIM, Superintendent, Centralized Electrical Maintenance, Lukens Steel Co., Coatesville, Pa.

J. W. DEIMLER, Assistant Superintendent, Maintenance, Alan Wood Steel Co., Conshohocken, Pa.

H. H. Angel: Has Mr. Deimler compared the figures of horsepower consumption against figures which G-E and Westinghouse have available, in which a curve is plotted showing the horsepower hours per ton against per cent reduction of products which are rolled similar in size to what he has? For example, I have seen many charts these companies have worked up where they show the rolling of ingots into slabs, or into blooms, or into plates, and only by selecting a curve which shows a product similar to what you have can you arrive at a comparative figure. I would also like to know if there is a long interval of time between the rolling of these plates, or are they rolled at a comparatively fast rate, where the interval of time is very short?

M. B. Antrim: One question occurs to me as a result of a statement which Mr. Deimler made during his talk concerning the increase of power necessary to roll this type of plate with areas which are not reduced. I believe the author said increased power was necessary, however, it would seem since all of the area of the plate is not being reduced that perhaps less power would be required.

J. W. Deimler: Mr. Angel, in answer to your first question relative to a comparison of figures, or my figures, with data available from the manufacturers, we actually worked in conjunction with one of them in this particular job and the only figures they had available were for smooth plate, which we used as a guide in our particular consideration.

Now I can answer Mr. Antrim's question at the same time and say we had to increase the power requirement by the 33 per cent because of the rolling of the diamond pattern. In the diamond pattern, although the area is not reduced, has to be squeezed into the recess which is ground into the roll, and you are actually doing additional work in working the metal into the diamond form. That was the reason for adding the 33 per cent, which we found, from some of our other mills where we roll the diamond pattern, to be a fairly safe approximation. There is no data available on rolling diamond patterns to my knowledge.

Now, relative to Mr. Angel's second question on the heating of the motor, I passed over that hurriedly. The installation as it exists has forced ventilation, so that we overcame or thought we would overcome our traditional heating. Furthermore, the pass-time was relatively short as compared to the elapsed time between sheets. Although this was a single pass, and the sheets came through fairly rapidly, it proved out in final operation that there was, I would say, twice as long an elapsed time between sheets as there was for the pass-time, itself.

PLAN TO ATTEND

AISE SPRING CONFERENCE

NETHERLAND PLAZA HOTEL

CINCINNATI, OHIO

APRIL 28 - 29, 1952

Some New Rolling Mills
IN THE UNITED KINGDOM

. . . . these papers are condensed from several presented in London, England, June 13 and 14, 1951, at the Seventh Plant Engineering Conference, of the British Iron and Steel Research Association . . . . theme of the symposium was "The Design of Rolling Mills" . . . .

THE NEW 42-IN. SLABBING MILL AT SHOTTON

By J. F. R. JONES

▲ THE new slabbing mill at Shotton replaced a 40 in. mill capable of producing slabs of a maximum width of 45 in. As the hot strip mill is capable of rolling slabs up to 54 in. wide, the original slabbing mill necessitated cross rolling for all slabs over about 40 in. wide. The new mill was designed to roll slabs of the full width the hot strip was capable of taking.

The time taken to install the new mill was 28 days from the time the previous mill ceased rolling to rolling the first ingot in the new mill on the same site. A factor which governed much of the designing was that the mill had to be put on existing foundations, and was to be driven from the existing three-cylinder horizontal steam engine.

The mill itself has roll housings of closed top type, with minimum cross sectional post areas of 500 sq in.; they have been specially designed to accommodate the necessary maximum lift on the top roll of 61 in. The housings are lined on the insides of the windows with steel wearing plates for the sides of the top chocks and the sides and bottoms of the bottom chocks. The housings are carried on continuous heavy box section bedplates specifically designed to seat on the existing foundations.

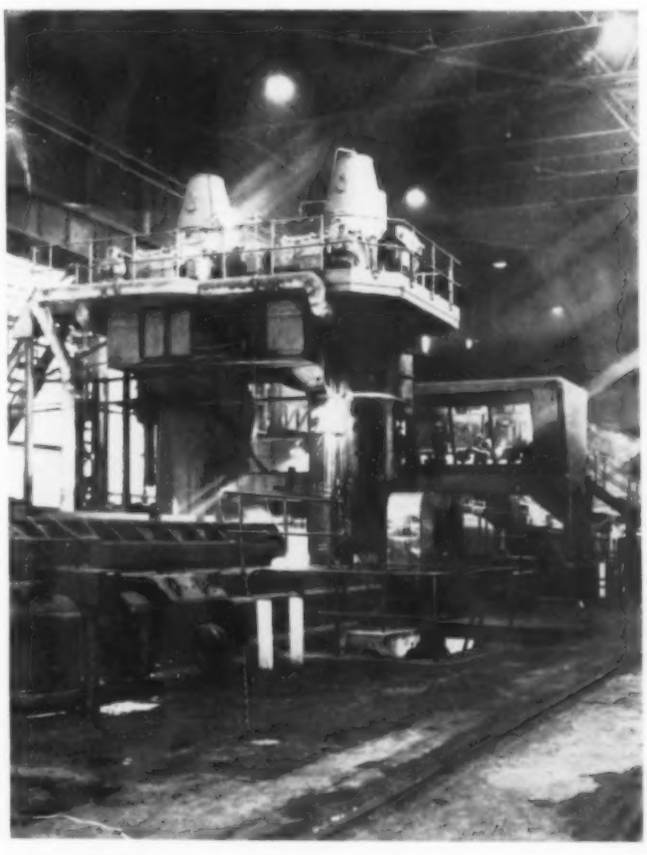
Cast steel chocks are used and are fitted with bearings of the flood oil-lubricated type for the roll necks. The two bottom chocks are mounted on a heavy cast steel sledge by which both rolls can be drawn out simultaneously for roll changing. Withdrawal of the roll changing sledge on to the fabricated runout brings with it both rolls and chocks in the one operation. This is effected by wire ropes passing over pulleys from a rope driving drum powered by a 30 hp electric motor through a reduction gear unit.

Screwdown gear is supplied with a twin-motor electric drive from two 150 hp motors which give a roll lift speed of 250 in. per minute. Both the screwdown and index gear, which is also fitted to the housings, are designed for the maximum required lift of 61 in., the position of the top roll being shown on a dial indicator with two moving fingers to indicate the slabbing and edging passes. There are two additional indicators mounted on the end of each screw which register fine settings down to $\frac{1}{16}$ in., these indicators being illuminated and visible to the mill operators.

The 16-in. diameter screws are driven through totally enclosed spur gear and worm gearing, the worm gears being enclosed in cast steel boxes secured to the housing tops, and arranged to form a receptacle for oil by which the worms are provided with constant lubrication. The two worms are connected together by a center shaft having a flexible coupling at one end and a disengaging clutch at the other, thus providing means by which the rolls can be paralleled. The tops of the screws are enclosed in fabricated steel hoods and the lower portions in telescopic gunmetal tubes. Flexible couplings and brakes are fitted on each screwdown motor. Lubrication for the worm boxes is supplied from the existing system.

Top roll balance is provided from two hydraulic cylinders carried in the housing tops and having 12-in. diameter cast iron rams made for a hydraulic working pressure of 700-750 psi. The ram of each cylinder is connected by crosshead, levers and links to two balance beams running across between the housings and secured to the top rider chocks, the balancing effort being transmitted to the carrier chocks by special bolts which are removed when roll changing. The hydraulic service for the top roll balance is provided by a 100-gal capacity air-loaded accumulator fitted with patented control

Figure 1 — Mill is shown from open side. Note control pulpit.



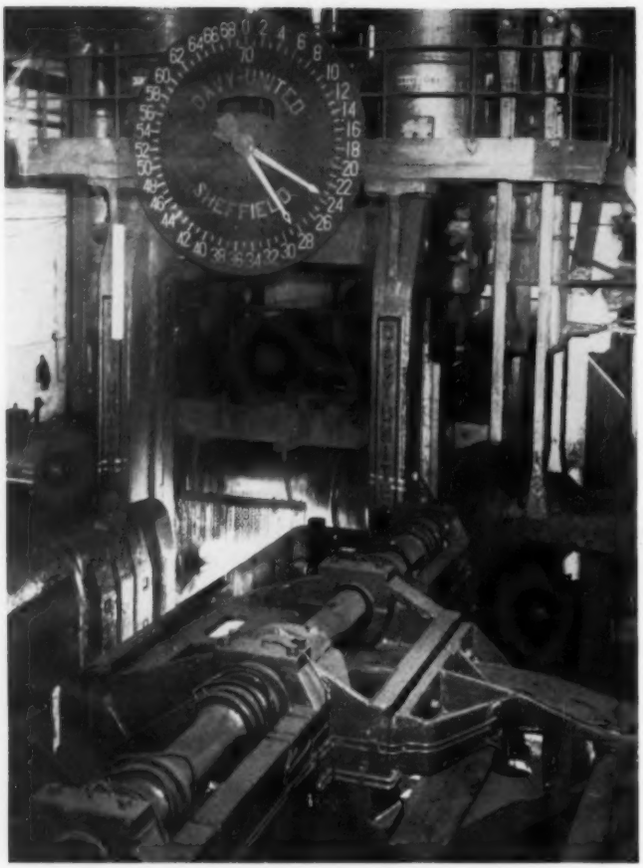


Figure 2 — Closeup of mill from entry side.

gear and designed for a working pressure of 750 psi. It is provided with an air compressor for charging the air bottles and an electrically driven pump by which is maintained the volume of pressure water in the accumulator.

MILL DRIVE

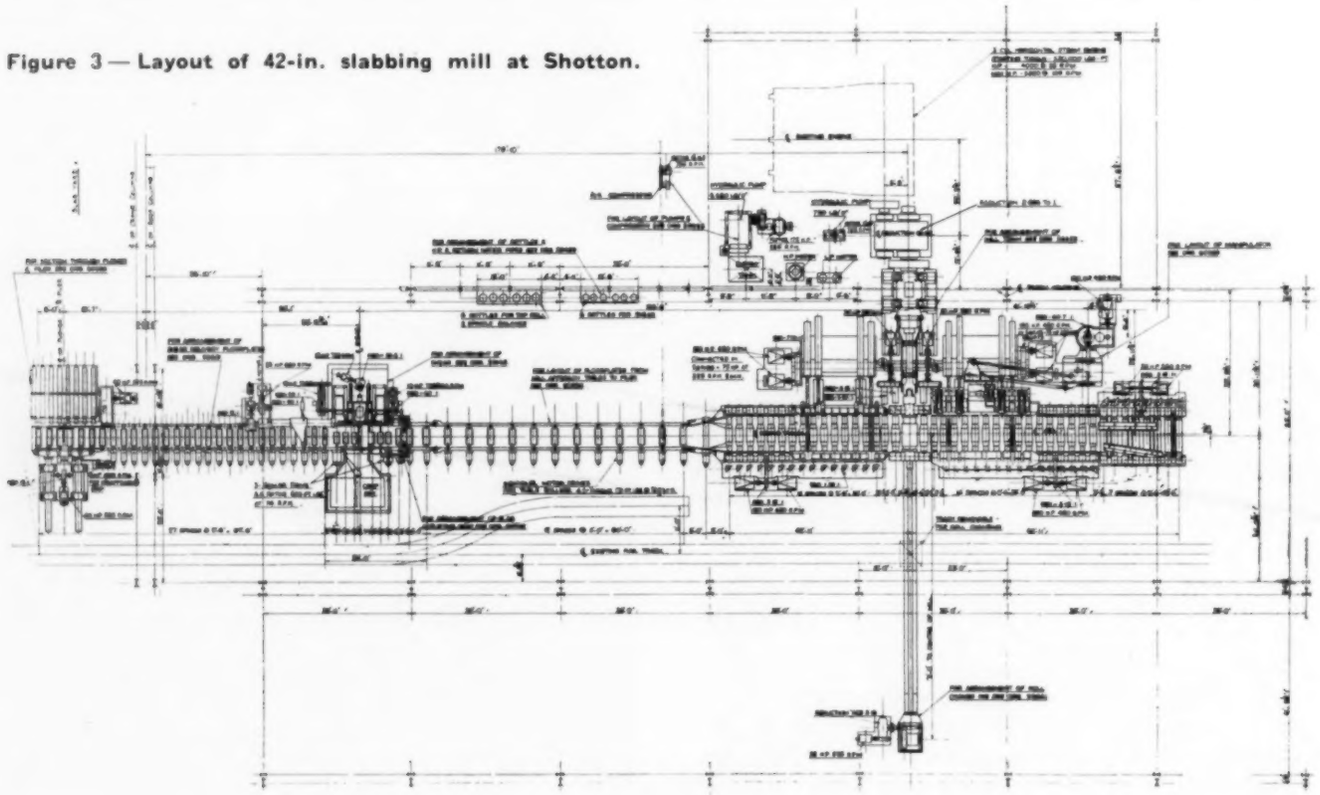
The mill is driven by an existing three-cylinder horizontal steam engine with a nominal horsepower of 4000 at 55 rpm and a maximum horsepower of 5300 at 105 rpm. The only modification carried out on this drive was to the existing reduction gear box; the gear ratio on the original mill was approximately 2¼:1; and this has been increased to 3:1.

The drive is transmitted to the reduction gear unit by flexible coupling while a further coupling of the same type connects the gear box to the new pinion housing which is of the totally enclosed type with spray lubrication to the pinion teeth. From the pinion housing, the drive is transmitted to the mill by coupling spindles provided with couplings of the universal jaw end type arranged for lubrication from the central system at the pinion housing end, and at the mill end for grease gun lubrication.

Hydraulic balance is provided for both top and bottom spindles by the same hydraulic system as provided for the top roll balance gear with suitable isolating valves interposed which can lock the hydraulic fluid and hold the spindles in position during roll changing.

The manipulator hands, which are 25 ft 6 in. long overall and are fitted with separate cast steel wearing faces, are each motivated from a pair of slab rams with racks operated by pinions carried on long shafts and driven by electric motors through a double reduction gear unit. The side-guard travel is 7 ft 7½ in., while provision is also made for 2 ft 3 in. over travel on the drive side heads to allow for the removal of rollers in the main mill tables. The heads on the ingoing side have

Figure 3 — Layout of 42-in. slabbing mill at Shotton.



a general depth of 4 ft to enable them to handle the largest size of slab ingot projected.

Both heads on the ingoing side are connected through pinion shafts to the corresponding heads on the outgoing side of the mill, thus ensuring that when the slab is entered at either side of the mill, the opposing heads are always positioned in the exactly corresponding position opposite the roll gate at the other side of the mill. By this means, the slab leaves the rolls perfectly straight. The slab rams themselves are guided in phosphor bronze liners which are fixed in the roller table frames.

The tilting gear is an interesting feature and is somewhat novel. The arrangement decided upon was that the motion on the tilting finger shaft should be transmitted via a pair of toothed quadrants, one keyed to the shaft and the other receiving its motion in turn from a long connecting rod arranged, to overcome lateral space shortage, approximately parallel to the tilting finger shaft itself. From a 100-hp motor the drive is effected through a reduction gear box and crank mechanism which is connected to the main long connecting rod by a shorter connecting rod and bell-crank lever.

The bell-crank lever is anchored at a fixed fulcrum point on a rectangular block arranged to slide in a fixed housing. This floating arrangement is specifically designed to accommodate the lateral movement of the tilting head during racking operations. A second long connecting rod parallel to the main tilting connecting rod constrains the fixed fulcrum pin to accommodate its position in relation to the movement of the head.

A further important feature of this tilting mechanism is that the driving elements are fixed on foundations, thus eliminating any necessity for trailing cables, and reducing the weight of the moving parts to a minimum.

The parallel heads on the outgoing side of the mill are not fitted with tilting equipment.

The first and breast rollers on both sides of the mill are driven by independent motors through flexible couplings and independent gear boxes. The breast rollers proper are loose on their shafts.

Existing main roller table frames were retained but new rollers were fitted with stepped diameters to match the mill rolls. This feature results in a very minimum of noise and shock when the piece enters and leaves the mill.

Roll cooling is effected by sprays from a water box carried between the two balance beams for the top roll. Mill screws are oil lubricated from the central system; chock slide, spindle bearing and breast roller lubrication is effected by an automatic grease system operated by pump and motor. Scale disposal is effected by hydraulic sluicing under the tables and by scraper conveyors under the mill, the scale being deposited in boxes at suitable collection points.

The mill is operated by a three-man crew housed in a control cabin of modern design positioned above and athwart the mill approach table. The mill is fed direct from the soaking pit bay by remotely controlled traveling ingot car.

From the mill, the slabs travel down the continuous roller table to an open-sided up-cutting hydraulic slab shear which forms the other major unit of this new mill installation. This shear is capable of cutting slabs 55 in. wide by 5 in. thick or equivalent section up to a maximum thickness of 8 in. It has a maximum blade load of 900 tons with a maximum stroke of 12 in. The blades are 60 in. long. Having a main ram diameter of 25 in. and employing a working pressure of up to 4500 psi, the shear is capable of making three cuts per minute continuously. Again, this major item of equipment was required to fit on to previous foundations.

From the shear the lengths of sheared slab pass on to an existing piler to which has been fitted a new piler table. From the table slabs in piles of six are lifted by crane and deposited in the slab stock bay to await ultimate reheating for rolling through the continuous hot mill line.

NEW BLOOMING AND BILLET MILLS AT NORMANDY PARK STEEL WORKS OF JOHN LYSAGHT'S SCUNTHORPE WORKS, LTD.

By J. A. PEACOCK, M. I. C. E.

▲ THE new rolling mill plant at the Normandy Park Works of John Lysaght's Scunthorpe Works Limited is the first section of the post war reconstruction to be completed. The intended ingot capacity is 10,500 tons per week rolled into sheet bar, billets and slabs from ingots of approximately four tons weight. The new mills consist of a 42-in. × 8 ft-6 in. blooming mill and a six-stand, 19-in. continuous billet and sheet bar mill.

Products for which the mills were designed are as follows:

Billets—2, 2¼, 2½, 3, 3½ and 4 in.

Sheet bar—All widths from 8 to 16 in. to a minimum thickness of ¼ in.

Slabs—8 to 16 in. in width, 1¼ to 2 in. thick.

The grades of steel also vary widely as shown by the following:

Billets—Mild steel and carbon steels up to 0.65 per cent carbon including forging steels, free cutting steel and leaded steels.

Sheet bar—Low carbon steels for galvanized sheets, carbon rimming steels for the motor trade and other pressings. Silicon steels from 0.25 per cent silicon up to 4.0 per cent silicon and carbon steels up to 0.40 per cent.

The products rolled to date have been billets 37 per cent, sheet bar 49 per cent and slabs, 14 per cent. Customer requirements dictate alternate weeks on billets and sheet bar, with slabs rolled in the sheet bar rolling periods as required.

To give some idea of the diversity of products the following is an analysis of one weeks rolling of 17 shifts, the finished output for that particular week being 8322 tons of sheet bar.

	Per cent
Between 0.25 and 0.3 in. thick	37
Between 0.3 and 0.45 in. thick	39
Between 0.45 and 0.6 in. thick	15
Between 0.6 and 0.85 in. thick	7
Between 0.85 and 0.95 in. thick	2
	100

Of this, 57 per cent was silicon steel varying from ½ to 4 per cent silicon.

Three batteries of recuperative soaking pits are installed, each battery consisting of four holes fired by a

TABLE I

BUILDING AND CRANE DATA

	Building length, ft	Cranes		
		No.	Capacity and type	Span, ft
Stripper and soaking pit bay	958	2	6-ton strippers	85
		2	6-ton chargers	85
Mill bay	1220	1	25-ton 15-ton twin hook auxiliary	70
		1	15-ton twin-hook	70
Billet storage bay	800	1	15-ton twin-hook	70
		1	15-ton twin-hook	85
		1	5-ton auxiliary	85

mixture of blast furnace and coke oven gas, having a calorific value of 135 Btu. Each hole is 25 ft long by 7 ft 6 in. wide, 10 ft 3 in. deep, accommodating 18 ingots. The control of the pits is fully automatic. A special feature is that the lids are operated by the charger driver from his cab on approaching or leaving the pit, by remote control.

The ingot buggy feeding the mill from the soaking pits is driven by a 60 hp motor, and travels a maximum distance of 200 ft. It is capable of a speed of 520 fpm.

BLOOMING MILL

The ingoing table is divided into three sections:

1. The approach and ingoing receiving table, comprising 9 rollers 18 in. diameter × 5 ft long at 2 ft 6 in. pitch with 60 hp drive. Speed of rack, 370 fpm.
2. The approach extension table with 24 rollers 18 in. diam × 8 ft 3 in. long at 2 ft 6 in. pitch with two drives, 60 hp and 100 hp. Speed of rack, 450 fpm.
3. Ingoing main table with 8 rollers 18 in. diam × 8 ft 6 in. long at 2 ft 6 in. pitch, with 100 hp drive. Speed of rack, 450 fpm.

On the delivery side there are two tables leading to the deseamer approach rack:

1. Outgoing table with 8 rollers, 18 in. diam × 8 ft 6 in. long at 2 ft 6 in. pitch, with 100 hp drive. Speed of rack, 450 fpm.
2. Intermediate run-out table with 17 rollers, 18 in. diam × 8 ft 3 in. long at 4 ft pitch, with 100 hp drive. Speed of rack, 450 fpm.

The mill table frames are cast steel of trough construction with fabricated covers, all gears being totally enclosed. Withdrawal gear is provided on the line shaft to permit dis-engagement of the gears, enabling any roller to be lifted out for replacement or repairs.

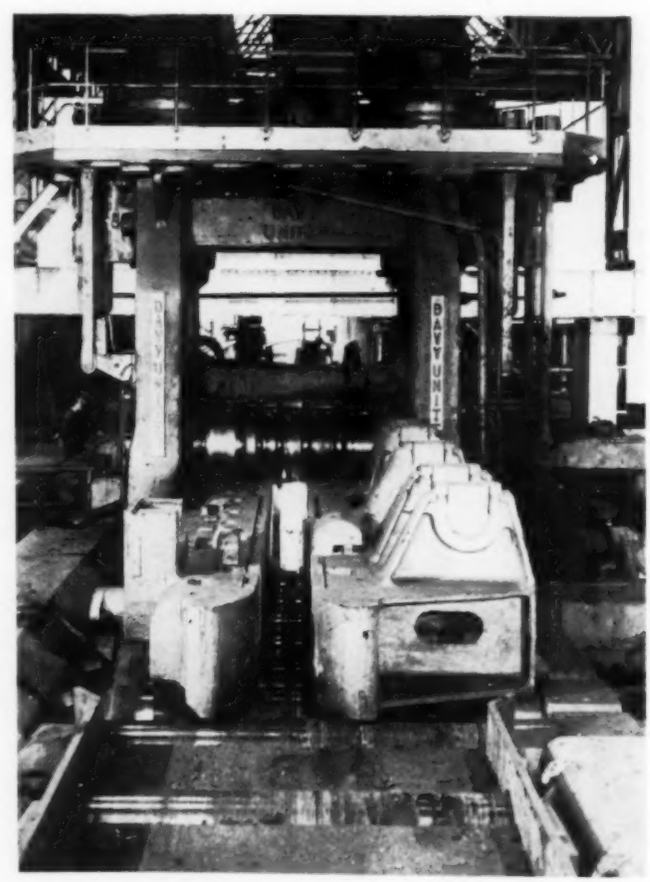
The gear boxes are integral with the table frames. The roller journals on all racks are cast iron bearings and caps combined, with cast steel bottom steps, white metal lined. The line shaft bearings are cast iron caps with cast steel top and bottom steps, white metal lined. All bevel gears are forged steel with machine cut teeth. The rollers are fixed to the shafts by a light shrink fit at one end and keyed at the other end. All roller table motors are duplicated on site, one on either side of each gear box, with one motor coupled up through a flexible coupling. In the event of a motor breakdown, that motor is uncoupled, and the one on the other side of the gear box coupled up, enabling the mill to start again with the minimum delay.

The electrical supply for the new mills is taken from the National Grid System at 33 kv. From our 33 kv switchgear, power at 3.3 kv is supplied to the mills through two 10,000 kva transformers. The 500 volt d-c supply is obtained through rotary converters operating from the 3.3 kv supply.

The main mill motor is a direct current, forced ventilated, reversing machine, having an rms output of 6650 hp at 62 rpm. The speed control is by variable armature voltage from 0 to 62 rpm, and by field weakening from 62 to 150 rpm. Minimum reversal time does not exceed 1.5 seconds.

This machine is supplied by a motor-generator set, comprising a 5000 hp slip ring induction motor coupled to a flywheel equipment, having a stored energy of 208,000 hp-sec, and three d-c generators each having an output of 1740 kw. The three generators are arranged

Figure 1 — Exit side of 3 ft 6 in. x 8 ft 6 in. blooming mill.



for series operation and are connected by bare copper bus bars to the main mill motor. The set runs at 600 rpm synchronous speed, the three generators together having a peak output of 10,650 amp at 1362 volts.

Alongside the main set is an exciter set for supplying the main mill motor field and the variable voltage generator fields of the main set. The exciter set is driven by a 125-hp, 3300-volt, 3-phase, 50-cycle synchronous motor at 1000 rpm. The motor takes sufficient leading kva to correct the power factor of the 5000 hp motor to 0.95 lagging.

Front and rear table motors of the blooming mill, together with the screwdown equipment are Ward Leonard controlled, the table motors being 100 hp each and the two screwdown motors 150 hp each. These machines are 1 hour rated and forced ventilated. Two motor generator sets are provided for supplying power to these motors; each set consists of one screwdown generator, one front table generator and one rear table generator, and are driven by a 400-hp, 1000-rpm slip ring induction motor operated from the 440-volt supply. The respective generators of each set are connected in series with the two motors driving each table. With the exception of these machines which require refined control, the table motors are 1-hour rated 500 volt d-c mill type motors.

Manipulators are designed to operate at a speed of 137 fpm and are of the universal electrically operated side guard type with all actuating mechanism located on the main drive side of the mill. The manipulator heads are operated by four 100 hp motors through a double reduction gear unit, pinions and racks. One manipulator head is fitted with four finger tilting gear driven by an 80-hp motor through double reduction gear, crank drive, gears and rack.

The breast roller and first rollers at each side of the mill are friction driven through a reduction gear driven by a 40 hp motor, having independent drive.

The mill pinions are 43 in. pitch circle diameter, 63-in. face, machine cut, double helical, with 20 degree spiral angle. The pinion necks are 25 in. in diam, running in white metal lined bearings 33½ in. long.

Hydraulic balancing is used for both the top roll and spindles, the hydraulic services being provided by a self contained accumulator system with a working pressure of 750 psi.

The mill housings are cast steel, the posts having a minimum cross sectional area of 450 sq in. The roll chocks are cast steel, lined with white metal with phospher bronze inserts. The bearings are water cooled through the chocks.

The screw down gear is operated by two 150 hp motors driving double helical gears through flexible couplings, and is capable of transmitting 150/300 hp at 500 rpm. The screws are 14 in. outside diameter, 2 in. pitch single thread, running in phospher bronze nuts at 111 rpm giving a lift of 220 fpm. The total travel of the screws is 36 in.

The roll changing gear is of the sledge type, rope hauled, through a 25 hp gear box. As all the actuating mechanism of the manipulator is on the drive side of the mill, the roll changing sledge is entirely clear of obstruction.

The control pulpit is normally under the control of three men. The first has the control of the screwdown motors, front and rear tables, and the intermediate tables. He operates three controllers and two foot pedals.

The second operator, controlling the manipulator and tilts, has two controllers and two foot switches to operate.

The third operator controls the main roll drive, the breast rollers, and the approach table to bring ingots on to the intermediate table when required. He has only two controllers.

A deseaming machine is installed, designed to allow simultaneous deseaming, to depths of $\frac{1}{32}$-$\frac{3}{16}$ in., of the four sides of hot steel blooms of 5-10 in. square and slabs 5-16 in. wide by 2-5 in. The speed of the deseaming roller table is 100-300 fpm.

The machine is mounted astride the roller table between the blooming mill and the bloom shears, on a motor driven transfer carriage which runs on rails transversely to the roller table. Thus, the machine may be retracted when not in use, or for inspection and maintenance. Attached to the transfer carriage is an idle roller buggy which moves into the level roller table line when the machine is retracted.

The bloom shear, is an up-and-down cutting unit capable of cutting up to 144 sq in., exerting a maximum blade pressure of 700 tons. It is equipped with automatic holding down gear. The stop and measuring gear is suitable for all lengths of blooms between 3 ft 3 in. and 18 ft.

Following the bloom shears is a bloom pusher of the sack design to transfer the blooms onto a skid operated transfer bank with a capacity of 60 tons of blooms, the blooms being passed through to the adjacent storage building where they will be examined and dressed.

Crop ends are disposed down deflector chutes into a circular pit which houses a turn-table carrying three scrap loading skips.

The bloom shear motor is a 350-hp rms (650-hp peak), 300/900-rpm shunt characteristic 500 v d-c motor supplied by a motor-generator set comprising a 285-kw 500-v, d-c shunt wound generator, coupled to a 6-kw, 250-v d-c excitor. This set is driven by a 430-hp 3-phase, 50-cycle, 440-v, 980-rpm slip ring induction motor.

After cropping the blooms are passed along to either the billet mill or put on to the bloom bank.

Scale disposal consists of a closed system of water flushing by means of culverts under the roller tables and blooming mill housings. These connect to the scale pit and have sufficient fall to ensure a complete wash-down of scale. Beneath the blooming mill housings, and below the bottom roll level, a grid is fixed for collection of scrap ends from ingots, etc. which are too large to wash down by water pressure. Flushing water is provided at the rate of 500 gpm at 80 ft head. The scale pit is common to both the blooming mill and billet mill. The water is filtered through a grid, while the settled solids are de-watered on a rotary filter and passed out in the form of a cake for loading into wagons. The amount of scale recovered at the scale pit amounts to 2.7 per cent of steel rolled.

BILLET MILL

The billet and sheet bar mill is a six stand 19 in. continuous mill. Two sets of roll housings are provided,

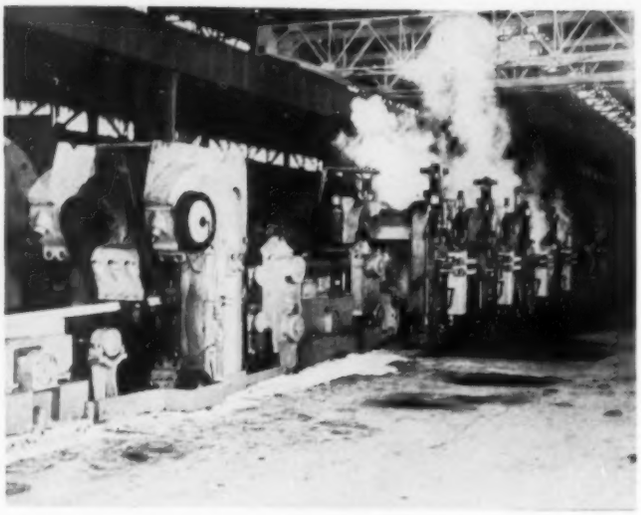


Figure 2 — The billet and sheet bar mill is a 19-in. six-stand unit.

one for billets and the other for sheet bar. The billet rolls have barrels 32 in. long, and the sheet bar roll barrels are 22½ in. long. The first four stands have rolls of 21 in. nominal diam with the last two 19 in. diam.

Preceding the mill train is an up-and-down cut crop shears for cropping the blooms or slabs entering the mill. Capable of cutting steel when at rest or in motion, the shears are driven from the mill transmission, and are actuated by a solenoid operated jaw clutch.

The six mill stands are driven by a 4000-hp motor running at 585 rpm through a single reduction helical gear box giving a reduction of 5.85 to 1 onto a common main shaft running at 100 rpm. Transmission to the six stands from the main shaft is by spiral bevel gears through pinion housings to each stand. The spiral bevel gears are arranged to give speeds as follows:

	Rpm
No. 1 stand	25.6
No. 2 stand	32.5
No. 3 stand	41.3
No. 4 stand	56.5
No. 5 stand	89.5
No. 6 stand	125.0

The mill has a delivery speed of 600 fpm.

When rolling sheet bar or slabs, there are two vertical edging mills in use, one situated in front of No. 1 stand and the other between No. 2 and 3 stands. These mills are driven by two 125-hp, 400/800-rpm shunt wound, 5-hr rated mill type motors, which are forced ventilated and supplied from the 500-v d-c system. The speeds may be varied by field rheostats mounted on a desk immediately opposite the entrance to the mill. An emergency stop button is provided on the desk to trip the 4000 hp driving motor in the event of a "cobble."

The roll housings are of steel with a closed top, and the rolls are adjusted for gap by means of screw operated bottom wedges. The top roll can also be moved for pass adjustment by means of a turnbuckle device.

The housings are equipped with oil-flooded bearings, which are set up on the rolls in the roll shop and transported to the mill in pairs, being placed conveniently for the mill crane to handle.

There are four twist roller guides in the billet mill. When rolling billets, the bloom turns 90 degrees between stands No. 1 and 2, 45 degrees between stands No. 2 and 3, 90 degrees between stands No. 3 and 4, and 90 degrees between stands No. 5 and 6, leaving No. 6 stand as a square on edge. The same procedure applies when stands No. 5 and 6 are dummied and the billet finished in stand No. 4.

The distance between roll stands is spanned by six tables which support and direct the billets, and also operate as looping tables when rolling sheet bar. The same spindles are used for connecting up both sets of roll housings, although the sheet bar rolls are 10 in. shorter than the billet rolls. To keep the driving faces in approximately the same position in the roll and wobbler boxes, cast iron blocks are inserted behind the spindles in the driving coupling boxes when the sheet bar housings are in use.

The set of housings not in use are made up and rolls mounted in close proximity to the mill, and the housings interchanged one by one. To mount the rolls, a special rig attached to the crane hook picks up the roll by the wobbler end, complete with bearings, and puts the roll into position in the housing.

The electric flying billet shear is the first of its type to be installed in Britain, and has a capacity of 16 sq in. cross sectional area, either 4 × 4 in. or 16 × 1 in. The function of this shear is to crop the front end and to continue to cut the billet or sheet bar up into definite lengths as pre-set by the operator. The range of length of cut is 15-30 ft. The speed of the shear is 250/628 fpm.

This shear consists essentially of two blades each mounted on a crank. To each crank is attached a tail rod, at the rear end of which is a roller guided by a specially designed groove in a fixed cam plate. This permits parallel operation of the blades during the cutting part of the cycle.

A roller table driven by a variable speed motor delivers the billet from the mill to the shear. Just beyond stand No. 6 is a flag switch for automatically starting and stopping the shear. A measuring roll located between stand 6 and the shear measures the speed of the billet or sheet bar, and is directly connected to a tach-

TABLE II

OIL SYSTEM DATA

No.	Main storage capacity, gal	Pressure tank capacity, gal	Circulating pump capacity, gpm	Centrifuge capacity, gal per hr	Equipment served
1	3250	1000	140	400	Blooming mill tables.
1	1600	500	50	400	Blooming mill pinions, screws, etc.
1	8300	3000	250	400	Billet mill drive gears, pinions, shear, etc.
1	1000	330	15	400	Billet mill roll neck bearings.

ometer generator for remote indication of the delivery speed of the material.

The shear makes a cut every revolution, and since it has a 9 ft blade circle, it would cut a billet into 9 ft lengths if it ran continuously at billet speed. If the shear is slowed down just as the blades clear the billet and allowed to run at slow speed, and then reaccelerated to billet speed time for the shear blades to engage the billet for the next cut, the length of billet will be more than 9 ft. Thus the slow speed at which the shear runs between cuts determines the lengths of the billet or bar.

The flying shear is driven by four mill type, forced ventilated, totally enclosed motors, each rated at 200 hp at 244 rpm, these motors being supplied by a motor-generator set consisting of a 500-kw, 1000-rpm, 600-volt peak, shunt wound generator, driven by a 750-hp, 0.8 power factor, 3300-volt, 3-phase, 50-cycle synchronous motor. The control for the shear motors and generator is supplied by an exciter set comprising three generators, driven by a 75-hp, 440-volt induction motor.

A flying shear roller table about 150 ft long connects the flying shear to the cooling banks. About 70 ft of this table is arranged for intensive water spraying of sheet bars. This table is also provided with a tilting section which enables delivery of sheared bars to an elevated pair of pinch rolls used for assembling sheet bars in piles. When these piling rolls are not in use the tilting section of the table can be depressed to enable billets to pass forward under the bottom roll. Piling bins for sheet bars are also provided, capable of stacking bars of up to 16 in. wide in piles up to 30 in. high. These piles are removed from the bins and are deposited for cooling on the banks.

After leaving the flying shear roller table, sheared billets are assembled in batches, representing the product of a 4-ton ingot, on a special skew roller assembly table ready for their advance to the cooling beds, which project into the billet storage bay and are furnished with piling bins into which the billets are cascaded for slinging and loading.

There are four main lubricating systems, some details of which are given in Table II. In addition there are oil systems serving the main mill motor, motor-generator set and various mill auxiliaries. Four automatic grease systems serve the blooming mill roll neck bearings, screwdown, shears, etc.

ROD AND BAR MILL AT GUEST KEEN AND NETTLEFOLDS, LTD., CARDIFF

By G. A. PHIPPS

▲ THIS mill was designed to meet a demand for steel free from rolling and surface defects and also, when rolling sizes between No. 4 gage and 1 in. in diameter, to roll to a tolerance of 0.010 in. Figure 1 shows the mill layout, and Table I gives mill drive data.

Figure 2 shows the main mill motor house and all the motors for the roughing, intermediate and looping trains, together with motor-generator set comprising a 4750-kva synchronous motor operating on 11,000 volts driving three 500-volt, d-c generators, one of 2000 and two of 1500-kw capacity. These three generators can be coupled together to supply power to all the mill or, alternatively, one generator can supply current to the roughing and intermediate trains, one to the looping train and the remaining generator supplying the motor of the rod finishing train. On the gallery can be seen the motor operated rheostats together with excitor sets, cemf sets, booster sets, etc., and below the mill control panels. Below the floor of the motorhouse is a basement covering the whole area with the exception of that portion occupied by foundations of the mill motors and generators. Here all the mill motor cables and main incoming cables are located. Air under pressure is fed into the basement for the motors and generators from two fans having a capacity of 50,000 cfm of filtered air which is drawn through two banks of oil impregnated filters. The only other mill driving motor is that for the rod finishing train, and this is located adjacent to the mill gear box, is totally enclosed and cooled with air from a booster fan located in the motorhouse basement.

Billet skids are located under the billet storage crane and loads of 8-10 tons are transferred from the storage to the skids. The skids, which are power operated, carry the billets forward and deliver them to the roller gear feeding the billets to the furnace. The furnace conveyor roller gear is of conventional type with line-shaft and totally enclosed mitre boxes with splash lubrication, and is driven by a 15 hp motor at a speed of 300 fpm. To charge billets into the furnace a charging buggy is used, running on rails mounted above the roller gear and driven at a maximum speed of 180 fpm by a chain mounted on either side of the rollers of the conveyor. The gear for pushing billets down the furnace is operated by a 40-hp motor through reduction gearing and, a crank, a rocking shaft, levers and pusher bars. To push the billets from the furnace into the mill, a push-out gear is located on the opposite side of the furnace to the mill and consists of a pair of driven pinch

TABLE I

MILL DATA

Stand No.	Roll diameter, in.	Motor, hp	Motor, rpm	Max delivery speed, fpm
0- 1	16⅝	200/200/130	900/300/195	
2	16⅝	200/200/130	900/300/195	
3	16⅝	300/300/195	900/300/195	
4	14⅝	300/300/195	900/300/195	
5	14⅝	300/300/195	900/300/195	
6	13⅛	300/300/195	900/300/195	
7	13⅛	350/350/227.5	900/300/195	
8	13⅛	350/350/227.5	900/300/195	
9	13⅛	350/350/227.5	900/300/195	
10	13⅛	350/350/227.5	900/300/195	
11	13⅛	350/350/227.5	600/200/130	
12	13⅛	350/350/227.5	600/200/130	
13	11½	350/350/227.5	600/200/130	
14	11½	350/350/227.5	750/250/162.5	
15	11½	350/350/227.5	750/250/162.5	
16	11½	350/350/227.5	750/250/162.5	2150
17	10	1750/1750/1138	835/600/390	
18	10⅛			1740
19	10			
20	10			3750
21	10⅝			
22	10			5100

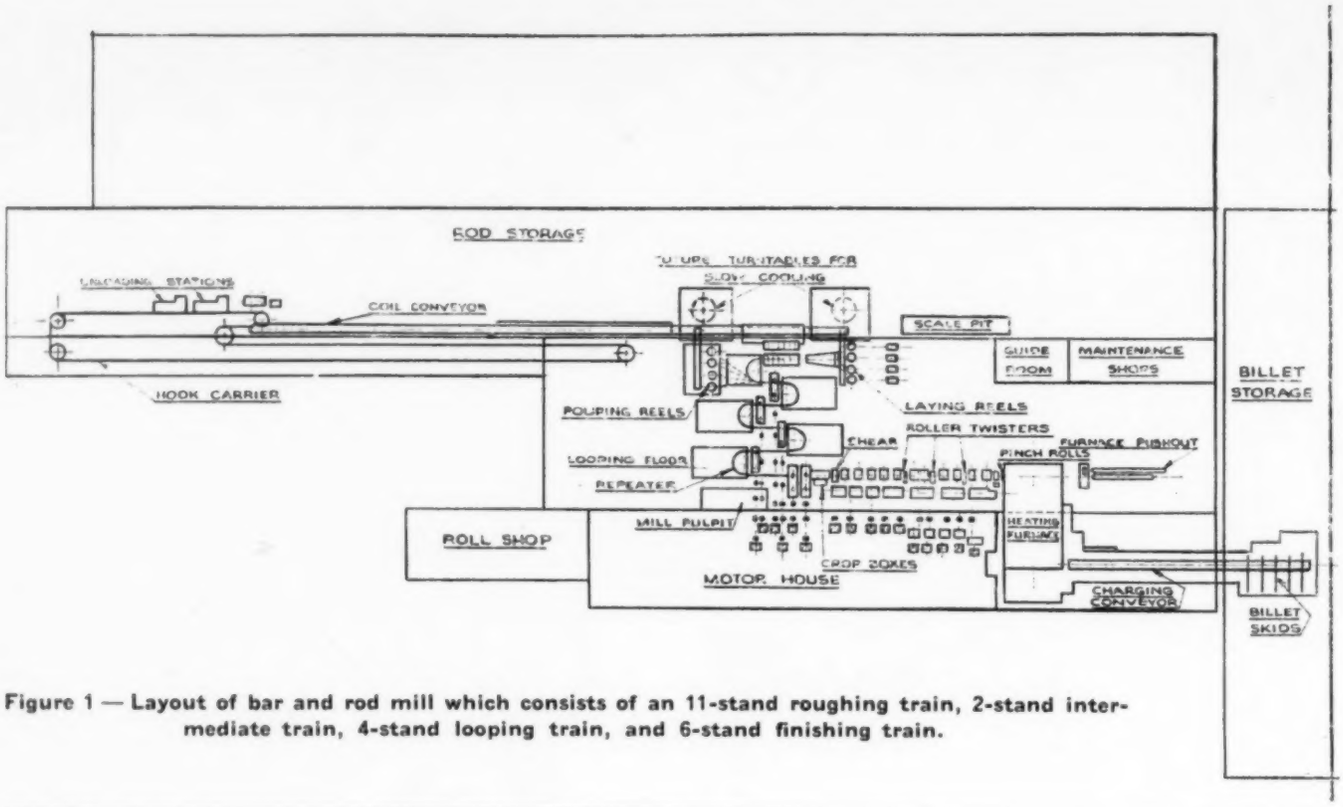


Figure 1 — Layout of bar and rod mill which consists of an 11-stand roughing train, 2-stand intermediate train, 4-stand looping train, and 6-stand finishing train.

rolls with the bottom roll fixed and the top roll spring-loaded. The pinch rolls drive a 2½ in. square push-out bar 38 ft long at a speed of 292 fpm.

The furnace is designed to heat billets 2¼ in. or 3 in. square, 30 ft long, at a rate up to 60 tons an hour. It is fired with clean mixed blast furnace and coke oven gas (calorific value, automatically controlled at 200 Btu per cu ft) through ten burners which are placed across the front wall in line and grouped in three zones, two burners at each end and six in the middle forming the three zones. The air for combustion is pre-heated through an external recuperator. A thermocouple, inserted from under the hearth in each of the three zones, controls the gas supply to each of the three zones independently. Changes in gas supply cause proportional changes in air supply through flow-ratio controllers. Furnace pressure is controlled by a power cylinder operating the stack damper and receiving its impulse from the furnace. Incoming gas pressure is also controlled by a similar system.

Located at the exit of the furnace is a furnace switchplate of the 2-strand type, which is used to deliver the billets into the mill. This switchplate is actuated by two air cylinders, one for cross traversing the distance of the strand centers of the mill and the other for lowering the switchplate in order to pass the billet being fed into the mill and so feed a billet into the next strand. Following the switchplate are a pair of pinch rolls, with diamond grooves for feeding the billets into the mill. The whole of the pinch roll unit can be moved hydraulically to line up with the mill passes in use.

Figure 3 shows some stands of the 11-stand roughing

Figure 2 — The main mill motor room has all the motors for the roughing, intermediate, and looping trains.

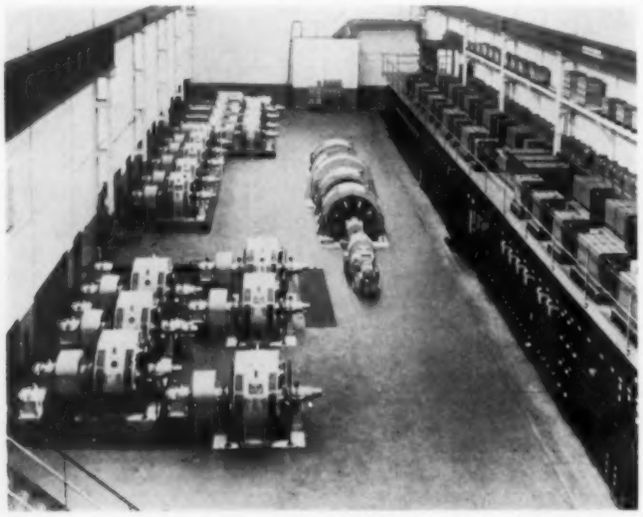
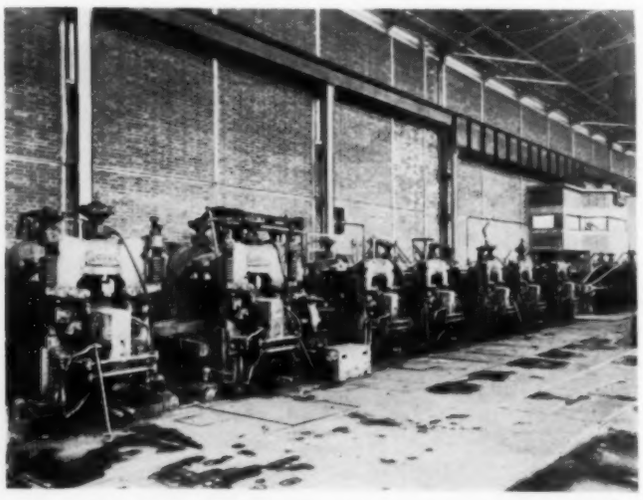


Figure 3 — The roughing stands are of the conventional type.



mill and it will be noted that the housings are of conventional type with normal screw adjustment of the top roll. The bearings are of the fluid film type, with the top roll spring balanced. The top roll is located and cannot be moved endwise. Provision is made for bottom roll adjustment and this is of the screw wedge type with individual adjustment to each bottom chock. Longitudinal adjustment is obtained on the bottom roll only, through a system of levers and screw adjustment. The same type of housings are used for the intermediate mill and also for the looping train. In the case of these latter housings, however, provision is made to traverse each set in the longitudinal direction of the barrel in order to align the passes in use with the repeaters or guide troughs to the repeaters. This is done by means of a hydraulic cylinder operating on each roll housing.

At the entry to the mill is a double strand up-and-down cut shear driven through gearing from the main mill motor driving stands No. 0-1 and actuated by means of a solenoid which sets in motion the mechanism to give one revolution of the shear and cut out. The shear is over-hung and is actuated by two eccentrics on a common shaft with the center eccentric operating the top blades and the two side eccentrics operating the bottom blades. The shear is controlled by three push-buttons whereby it is possible to cut on both lines or either one of the two lines. During the period of cutting, the whole shear moves forward with the passage of the billets when the billet is in the mill or, alternatively, remains stationary when cutting off the front end of a billet. In order to line up the shear with the passes in use in the mill, the whole shear is moved by means of a hydraulic cylinder and to allow for this movement in the driving end of the shear, a splined shaft is provided whereby the shaft moves and the gear wheel driving the shaft remains stationary.

In order to obviate scratching of the rods or bars due to solid twist guides, roller twist guides have been developed. In the older type of mill, a tight twist guide had to be used, whereas with rollers it is possible to use a loose guide to start the initial twist but immediately the piece enters the rollers, the rollers take over and control the stock and allow the twist guide, due to its excessive clearance to become inoperative after the roller has taken command. The twist roller guide used between stands No. 1 and 2, 3 and 4, and 5 and 6, are non-driven rolls mounted on roller bearings with a thrust bearing for each roll. The adjustment is common for both rolls and the link mechanism is arranged so that both rollers move with one operation of the actuating mechanism thereby maintaining the strand centers at all times.

When rolling sizes from No. 5 gage up to $\frac{9}{16}$ in. diam, it is essential to crop the front end of the stock prior to entering the intermediate and succeeding stands. This shear, electronically controlled and completely automatic for normal operation, has four circular blades mounted in pairs, one above the other; the bottom pair cuts the front end and the second pair is only used when a cobble occurs in the intermediate stand to cut and divert the material to scrap.

The light duty twist rollers which are used between stands No. 7 and 8, 9 and 10 and also after stands 13 and 15, are mounted on bars carried off brackets on

Figure 4 — Four pouring and laying reels are used.

the housings so that they can be moved across the housings in line with the passes in use and located with the delivery guide holder. These are again non-driven rollers and in this case, adjustment is in the vertical plane. The adjustment is by means of right and left-hand screws, and gearing mounted on top of the housing and by this means, the pass line in the mill is always maintained. The one set of rollers will deal with all the range of sizes rolled in the mill.

At stand No. 16, where the larger sizes of rounds produced in the mill are finished, it is essential to use a roller type guide to avoid the possibility of scratching. On the guide used here, there are four rollers mounted in pairs, running on small ball bearings. To date, this guide has proved very successful.

The repeaters of the looping mill are all provided with rollers mounted in the bulkhead, again with the object of eliminating scratching. The rollers are mounted on ball and roller bearings and rotate freely when the stock comes in contact with them.

Snap shears are provided at the looping stands in order to cut the stock in the event of a cobble occurring in the finishing or looping mills. These are of double knife type, spring-loaded, and are operated by means of solenoid with pushbuttons positioned in the mill pulpit and adjacent to the rod finishing train.

Spindles for the finishing mill are of gear type with the coupling boxes having internally cut gears and the spindles externally cut gears. These spindles run 1820 rpm and even at this speed operate without throw.

Figure 4 shows the laying reels used for sizes up to

⅜ in. in diameter. There are four reels all driven by one 50-hp motor at 600-1720 rpm. The motor drives four gear boxes with bevel gears and incorporated in each gear box is a clutch to enable any reel to be put out of operation. From these gear boxes, a spindle drives to the reel proper, where a further set of bevel gears are used for driving the shuttle which lays the rod between the reel pins. For stripping the reel, a 7½-hp motor lowers the reel pins after which another 7½-hp motor actuates the push-out mechanism which ejects the coil onto the conveyor. For sizes larger than ⅜ in., which are finished at stand No. 16, pipes leading from the stand deliver the bars to one of four pouring reels. These reels are each driven by 50-hp motor running at 520 to 1040 rpm and for stripping and pushing the coil off onto the conveyor, again, two 7½ hp motors are used. While it might appear that a 50-hp motor is large for this duty, it should be noted that it is required for acceleration and deceleration only, as when the motor is running at speed, the current taken is very low. With this type of mill it is essential, in order to get maximum production, that the reels should be able to accelerate and decelerate in a matter of a few seconds.

The coil conveyor is of double chain type driven by a 35-hp, 300-900 rpm motor through a triple reduction gear unit with a two-speed gear on the third motion shaft. The output shaft drives the conveyor chains and the hook carrier is driven from the output shaft by means of a chain and sprocket. The bearings of this gear box are of the white metal shell type, the gears are lubricated by splash, and the bearings obtain their lubricant by the splash from the gears.

There are six separate oil systems in the lubrication cellar supplying drives and bearings of the mill, each system operating on the principle of a main storage reservoir, electrically heated and thermostatically controlled, from which the oil is pumped through a self-cleaning filter and cooler to the bearings or meshing points of drives, returning by gravity flow to the reservoir. Each system has two supply pumps, one normally operating the other, cutting in automatically should pressure drop. Riding on the supply line is a pressure tank controlling the pressure switches which operate the pumps, warning sirens, signals, etc., and carrying an emergency supply of oil sufficient to clear the mill if total stoppage of pumps, due to power failure, should occur.

The oil can be by-passed from any reservoir through a centrifugal purifier for dehydration and cooling, by a selector panel insuring that the oil can only be returned to the particular reservoir from which it is drawn. Details of the systems are given in Table II.

The mill has only been in operation nine months, but due to the steel position and the demand for rods, it has only been possible to operate the mill continuously on sizes from No. 5 gage to ⅜ in. To date on No. 5 and No. 4 gage during a 17 shift week, 3150 tons has been obtained and the best shift to date on No. 5 rods is 217 tons in a 7½-hr shift.

TABLE II

OIL SYSTEM DATA

System	Circulating rate, gpm	Reservoir capacity, gal	Equipment served
A	200	6600	Drives for furnace pullout rolls; up-and-down cut shear; stands No. 0-16.
B	100	3300	Drives stands 17-22; laying reels and drives.
C	20	800 (Each of 2 tanks)	Roll neck bearings on stands No. 11-16.
D	22	800 (Each of 2 tanks)	Roll neck bearings on stands No. 0-10.
E	25	1000 (Each of 2 tanks)	Roll neck bearings on stands No. 17-22 incl.
F	30	1000 (Each of 2 tanks)	Pouring reels.

LIGHT SECTION MILL AT DARLINGTON AND SIMPSON ROLLING MILL CO., LTD.

By W. FRENCH

▲ THE modern light section mill was installed at Darlington at the end of December 1946 to cater for the expanding demands for the company's products in the light section field. The mill is the conventional cross country type and is so arranged as to give a great degree of flexibility in the method of rolling and the design of the commodity produced. Since precision rolling at high speed was sought, the criterion in the design of the mill was low rolling tolerances and surface finish.

The scheduled output was 75 tons per shift or 60,000 tons per annum, and this figure has been exceeded on a wide range of the products rolled. The weight of the sections produced is just over 1 lb per ft and a high standard of accuracy has been achieved in the products rolled.

In the layout an attempt was made to provide ample space for all operations and this resulted in a steel framed building of the brick pannelled type 1000 ft long, 100 ft wide and 38 ft 6 in. to the eaves.

Continuous glazing was provided in the roof and side walls to give adequate daylight lighting in the winter months and some thought was given to ensure that the amount of glazing was not excessive, having in mind the nature of the work and the summer months.

All the mill table rollers are of cast iron mounted on mild steel shafts keyed at one end and, to allow for expansion, free to slide on the shaft at the opposite end.

The billet shear approach and delivery rollers are mounted on cast iron frames and driven by an electric motor through totally enclosed reduction gears on to a line shaft running the full length of the tables. From the line shaft each roller is driven by totally enclosed and oil immersed mitre gear.

The mill approach and delivery rollers are of unit construction, each roller being fitted in a cast iron frame, one end of which is flanged for the reception of the motor driving unit. The roller is driven direct by an overhung direct coupled squirrel cage motor operating on a three-phase, 16-cycle a-c supply through a flexible coupling.

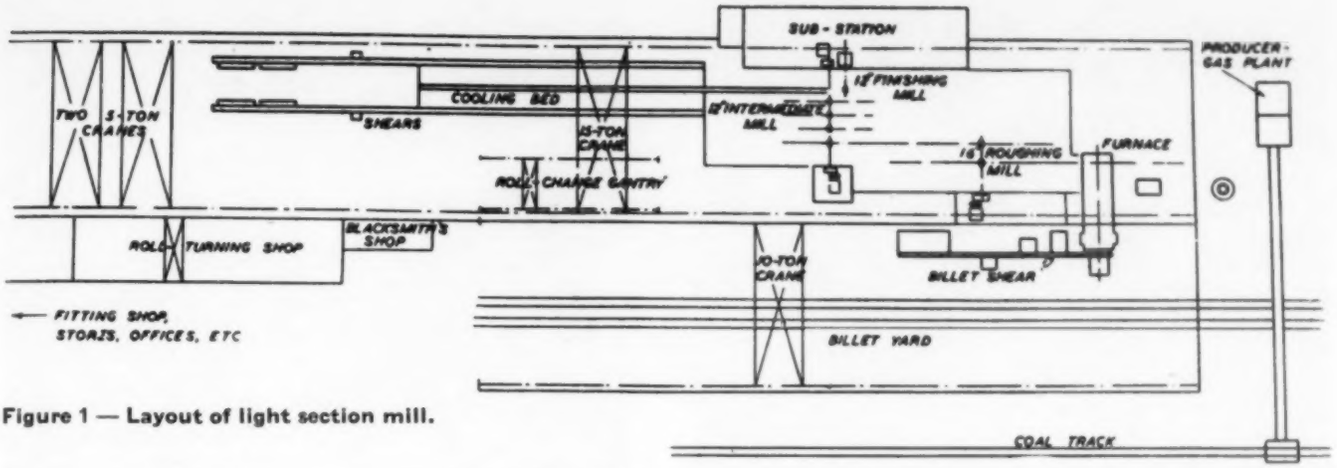


Figure 1 — Layout of light section mill.

Each set of mill stands except the final finishing stand is driven from the motor through a totally enclosed pressure lubricated double helical gear reduction set. The final finishing stand is driven direct from the motor. The high speed and low speed shafts of the gear sets are connected to the motor and pinion housing respectively by flexible couplings.

Some details of the mill drives are shown in Table I.

The roughing mill stands are driven by conventional type wobbler spindles and coupling boxes, the top and bottom spindles having their ends cambered slightly to counteract the misalignment of drive caused by large or small rolls. The spindles are supported at their centers by spring loaded carriers bolted to the mill bed plate.

The intermediate train of rolls is located with the first stand in line with the second roughing stand and at a distance of 85 ft from it. The train consists of a three-high set up with rolls for the bottom pass only, the second stand is three-high also but having rolls for the top pass only, and the third stand is two-high.

The first finishing stand is located in line with the intermediate train while the second finishing mill is set back from the intermediate train.

The three intermediate and finishing mills are driven from their respective pinion housings by means of universal type spindles, comprising a female cast steel coupling box, machined to fit the fluted wobbler end of the roll and fixed in position by means of a steel pin, and a cast steel male spindle fitted with phosphor bronze bush blocks having machined spherical surfaces. When the spindle and coupling boxes are assembled, the spherical surfaces of the male spindle form a driving surface with two phosphor bronze "slipper" pads fitted into the coupling box or "pod end," the whole universal unit being held in position by a steel pin passing through the pod end and the bush block.

The lubrication of the "universal joint" is by means of grease ways drilled through the above mentioned steel pins, giving access to grease grooves in the phosphor bronze bush block and pads. To facilitate removal of the mill housings, the male spindle is made in two parts, one part having a "four fluted" spline which fits inside the other part and is held in its longitudinal position by means of hardwood stretcher pieces. When it is necessary to change the mill housing, the stretcher piece is removed, together with the steel pin which holds the bush block in position, thus enabling the fluted part of the spindle to slide inside the other part and giving necessary clearance between the male and female portions of the universal spindles.

Each set of spindles is supported by means of a carrier stand, bolted to the mill bedplate and having sets of white metal lined bearings as required to suit either two or three high roll housings.

The roughing mill bearings consist of cast steel water cooled chocks lined with white metal. The intermediate and finishing mill bearings are carried in cast steel chocks fitted with roller bearings and with accurate means of adjustment. In view of the need for accurate rolling, the chocks fit neatly into closed top type mill

TABLE I

MILL DATA

Mill stands	Roll barrel length, in.	Drive, hp	Motor speed, rpm	Mill speed, rpm	Delivery speed, fpm	Flywheel energy storage, hpsec at 800 rpm
Roughing mill						
Two 16 in., 3-high	42	750	400-800	65-130	275-550	10,000
Intermediate mill						
Two 12½ in., 3-high	30	600	400-800	125-250	390-780	12,000
One 12½ in., 2-high	30					
First finishing mill						
One 12½ in., 2-high	18	600	400-800	175-350	550-1100	.....
Second finishing mill						
One 12½ in., 2-high	18	450	175-350	175-350	550-1100	.....

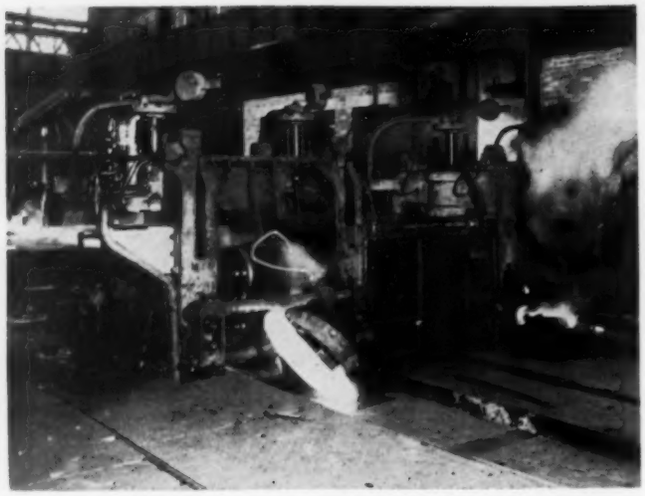


Figure 2 — Roughing mill consists of two 16-in., 3-high stands with 3 ft 6 in. long rolls.

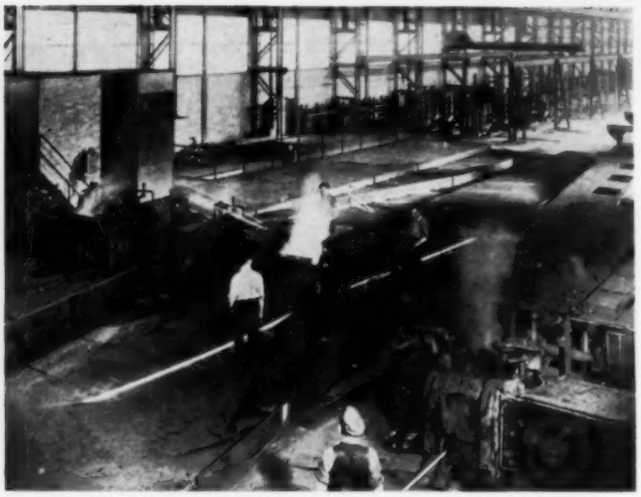


Figure 3 — Three intermediate and finishing mills are driven by universal spindles.

housings. The roll chocks are fixed positively at one end of the mill housing only, the opposite end being free to float in the opposite housing, thus catering for roll expansion, etc.

The roughing mill bearings are force fed grease lubricated from a motor driven lubricator mounted adjacent to each stand. The intermediate and finishing mill bearings are grease packed on assembly to a predetermined pressure, and during rolling operations additional grease is added by a high pressure grease gun through a grease nipple located near the wobbler end of the roll. As the roll neck is drilled and plugged at the end, grease can thus be fed to a small annular groove on the roll neck situated in the center of each bearing race.

Great care has been taken to ensure that the bearings are efficiently sealed against dirt and water. One of the advantages of the use of grease as a lubricant is its better sealing properties.

The adjusting of the top rolls of all stands is through a hand lever operating a "castle" nut which in turn operates the main screw. The operating lever is held in position by the usual pegged quadrant plate fixed to the housing.

The roughing mill top rolls are suspended from the open top housing cap by spring loaded suspension bolts attached to a roll neck carrier chock. The bottom roll is adjusted by a screwup gear operated by a hand ratchet operating a vertical shaft revolving in bearings attached to the housing. To the opposite end of the shaft is fitted a pinion operating a gear wheel screwed to receive the chock screws. The bottom rolls of the intermediate and finishing mills are adjusted by horizontal wedges and screws.

The mill is not fitted with mechanical manipulators, the bars being manually fed into the various passes. For certain sections both stands are fitted with repeaters bolted on the first roughing stand onto the cramp, and on the second roughing stand on both sides of the housings. When repeating in the first stand, overhead repeating is resorted to, but in the second stand repeating is done from bottom to top on one side and from top to bottom on the other side.

Tilting tables are fitted to the delivery side of both roughing stands. The tables are electrically operated from a master controller in the mill pulpit and facilities are provided to alter the height of the table in operating to suit varying roll diameters.

To handle mill scale, concrete ducts have been constructed beneath the roughing mill approach tables, the roughing and mill trains, with sufficient slope to enable the scale to be flushed with water into a central scale pit. This pit, located in the billet yard, is constructed with three weirs to settle out the scale before the water returns to the pump suction pit for recirculation. The accumulation of scale is regularly taken out by means of a grab fitted to the overhead crane.

A 450-ton shear is located in the billet yard on a concrete platform at furnace level to shear the raw material into desired lengths for charging. It is capable of cutting one 3½ in. billet or three 2 in. billets at each cut.

The two shears on the end of the cooling bank are of 60 tons capacity and are capable of cutting up to four bars at a time.

The cooling bank is of the double sided type with alternate fixed and moving toothed frames. The moving frame is operated from a series of shafts fitted with eccentrics, the shafts of which are attached to the moving frame support steelwork. The eccentric motion transfers the bar one tooth each complete cycle to a corresponding tooth in the fixed frame. This motion can either be continuous or for one tooth only.

The bar is delivered from the finishing mill over a chute with a mechanical switch and diverter which delivers alternate or successive bars on to a dual roller gear in the center of the bank. The dual rollers are conical in shape, 9 in. in diameter and are overhung on each side of the double shaft extension motor. The bars are discharged from the rollers onto the bed by a continuous kick off plate operated by a flag switch nested between the conical rollers.

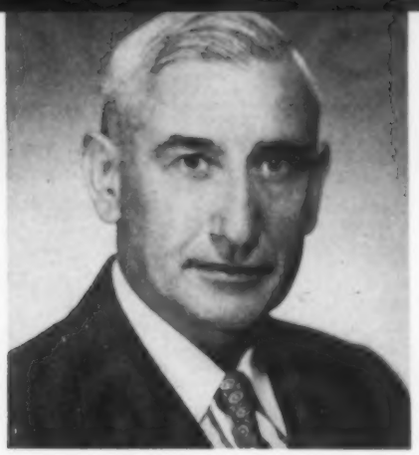
From the toothed frames, bars are transferred to the shear delivery rollers by shuffling arms. By the above arrangement, bars can be delivered from the mill traversed over the toothed bed and held if necessary on the shuffle arms until the shear delivery rollers are ready to receive them.

C. G. MARSHALL

BIRMINGHAM DISTRICT SECTION

A. M. CAMERON

BUFFALO DISTRICT SECTION



F. A. JOHANTGES

CHICAGO DISTRICT SECTION

AISE DISTRICT CHAIRMEN 1951 - 1952

C. G. MARSHALL was born and reared in Alabama. He received his BS in Electrical Engineering at the University of Alabama in 1940. After graduating was employed by the Tennessee Coal, Iron and Railroad Co. in the Coal Mining Division. Consecutively, he served as junior engineer, assistant electrical engineer, general maintenance foreman and electrical engineer. In 1949, he was made maintenance engineer, coal mines, which is the position he now holds. He is registered and entitled to practice professional engineering in the State of Alabama.

A. M. CAMERON was born in Pictou County, Nova Scotia, and educated in the Trenton, Nova Scotia, schools and at Carnegie Institute of Technology. He served his apprenticeship as a roll turner at the Nova Scotia Steel & Coal Co. and then moved to Crucible Steel Co. of America, Pittsburgh, Pa. He later worked as roll shop foreman at the Philadelphia Roll & Machine Co. and as roll designer for the Jessop Steel Co., Washington, Pa. In 1929, Mr. Cameron was employed as roll designer at Atlas Steels, Ltd., Welland, Ontario, and has since held positions of production planning, assistant superintendent of rolling and forging. In April, 1951, he was appointed superintendent of rolling mills and S. P. Forge.

F. A. JOHANTGES received a B.S.E.E degree from Purdue University in 1926; was in the General Electric Student Test Course for one year and then was transferred to their Chicago district in the service department. In 1928, he was transferred to their St. Louis district on construction and service work until 1936. He went to the Wisconsin Steel works of the International Harvester Co. in 1936 as a test engineer, advanced to assistant electrical engineer in 1939 and to electrical engineer in 1950.

WALTER W. BENTZ was born near Uniontown, Pa. in 1909, and attended public schools in Scottdale, Pa. He worked with the U. S. Pipe & Foundry Co. at Scottdale, Pa. from 1926 through 1932. He then secured a job with Carnegie Steel Co., McDonald plant, as motor inspector helper in 1933. He graduated from Bliss Electric School, Takoma Park, Md. with the class of 1935. He progressed at the McDonald plant as motor inspector, lineman, turn foreman, and general foreman electrical while attending night school classes until 1945. Promoted to assistant to superintendent of the department for the Youngstown district, Carnegie-Illinois Steel Co. and was later promoted to assistant superintendent electrical, superintendent of combined maintenance at the McDonald & Upper Union plant of Carnegie-Illinois. He is now employed as superintendent of maintenance shops and utilities at the McDonald plant of United States Steel Co., formerly Carnegie-Illinois Steel Co.

ROBERT SERGESON was born in Philadelphia, Pa., and graduated from University of Pennsylvania in 1922 with a BS in Chemical Engineering. He entered employ of the Central Steel Co., Massillon, Ohio, working in the metallurgical laboratory and subsequently in open hearth, soaking pits and bar mills. He remained with this company after its merger into Central Alloy Steel Co. and later into Republic Steel Corp., being in charge of the metallurgical laboratory for eight years. In 1938 Mr. Sergeson joined the Park works of the Crucible Steel Co. of America, Pittsburgh, Pa. as chief metallurgist, remaining till 1945 when he became chief metallurgical engineer of Rotary Electric Steel Co., Detroit, Mich.

JOHN S. MORRIS started his steel career as a looper in the Bethlehem Steel Co.'s training course at Bethlehem, Pa. in June 1928. He went to their Sparrows Point plant as a third helper in the open hearth, in September 1928, and then progressed through the jobs of second and first helper, open hearth combustion engineer, combustion engineer, finishing division, and assistant fuel engineer, finishing division. In July 1941 he accepted a job with the Alan Wood Steel Co. as assistant to general manager. From January 1942 to 1949, he was special projects engineer at the Lukens Steel Co. and from 1949 to 1951 supervisor of centralized maintenance cost control. In June 1951 he was appointed supervisor of construction, Lukens Steel Co., which position he now holds.

EMIL KERN was graduated from the University of Stuttgart, Germany, in 1926, and began his career as a machinist and designer with Mesta Machine Co. in 1930. He became associated with Reynolds Metals Co. as chief mechanical engineer in 1945 and joined the Allegheny Ludlum Steel Corp., Pittsburgh, Pa. as chief engineer the following year. In May 1949, he was elected a vice president of the Allegheny Ludlum Steel Corp.

WALTER W. BENTZ

CLEVELAND DISTRICT SECTION

ROBERT SERGESON

DETROIT DISTRICT SECTION

JOHN S. MORRIS

PHILADELPHIA DISTRICT SECTION

EMIL KERN

PITTSBURGH DISTRICT SECTION

MAINTENANCE OF OIL FILM BEARINGS

. . . . with well planned maintenance, oil-film bearings will give long life . . . .

By S. CARSON
Morgan Construction Co.
Worcester, Mass.

▲ This paper is confined to oil-film roll neck bearings, and most of my remarks will apply particularly to my company's bearings, as it is with this bearing that my experience originates.

My company has been building high production, continuous, two-high hot mills for about 64 years. These mills are designed to produce wire rods, merchant bars and small angles, skelp, sheet-bar and billets, and are in operation in practically every country where the manufacture of steel has assumed large enough proportions to warrant this type of mill. As the demands for rolled steel products developed, the speeds and loads of the mills increased, and the problem of adequate roll-neck bearings became more and more active. We started experimental work with a sleeve-type oil-film bearing, operating with hydrodynamic lubrication, which first went into operation in 1932 on a two-high, hot strip mill. This was the beginning of a development that is still going on, but the basic principle has remained unchanged. We have not been alone in this work. Another American company has its own type of oil-film bearing, and there is at least one other oil-film roll-neck bearing made in England.

DESCRIPTION

The principal parts of the bearings are few and simple. The sleeve "A" (Figure 1) is an alloy steel forging, heat-treated and ground to a mirror finish of approximately 2 to 4½ micro-inches, RMS as measured by profilometer. The sleeve has a taper bore which fits on and is keyed to the tapered roll-neck "B," thus becoming the journal. Surrounding the sleeve is the bushing "C," which is lined with centrifugally-cast cadmium-nickel bearing metal, accurately bored to give a highly finished bearing surface which carries the radial load. Adjacent to the outboard end of the sleeve is the thrust bearing "E" which is either a double acting roller or ball bearing, depending on the size of the radial bearing. The thrust bearing is independent of the radial bearing and can adjust itself to roll-neck deflection and other types of misalignment so common in rolling mill work. Earlier designs employed plate type thrust rings.

These principal parts with the enclosing chock "F" and the all important oil and water seals and end plates make up a compact roll-neck bearing. The assembly is secured to the roll-neck by a lock-nut "J" engaging split threaded-ring "K," and is mounted and removed as a unit.

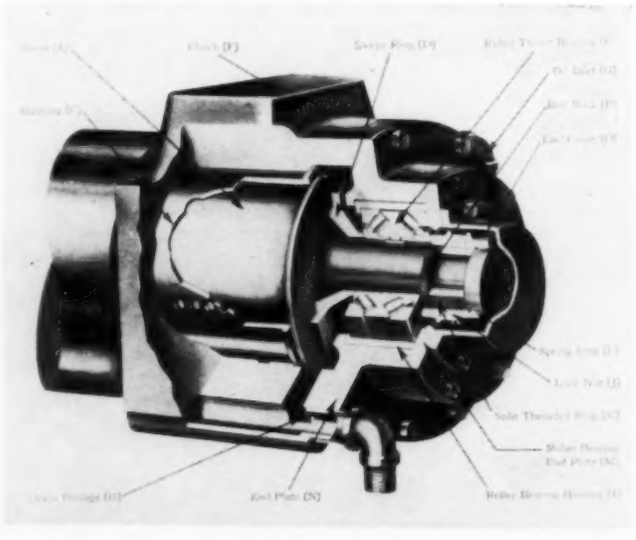
SEALING

When the lubricating oil has passed from between the sleeve and bushing it is no longer under pressure. This means that the oil seals merely serve as wipers to keep the lubricating oil in and prevent the rolling lubricant from entering the bearing. Until three years ago it was customary to have the inboard oil seal ride the outside diameter of the sleeve. Although the general results of this design were good the friction between sleeve and seal produced wear which, if the seals were not replaced in time, caused both loss of oil and contamination by the rolling lubricant. Although the wear of the sleeve was slight, years of operation meant an eventual reconditioning at the point of wear.

Our latest design incorporates a removable sleeve extension on which the oil seal rides, and serves as a baffle to prevent leakage of the lubricating oil. Another advantage of the sleeve extension is elimination of wear at the inboard end of the sleeve. When wear eventually reaches a critical point the extension can be replaced with a new one at a nominal cost.

On mills where no rolling lubricant is used, such as sheet and tin temper mills, the seal is replaced by a grooved ring and the flat surface of the sleeve extension, where the seal normally rides, is fluted to make flinger lips. This combination of extension and grooved ring, after three years of operation, has proved abso-

Figure 1 — This bearing with roller thrust is used on bearings 21 in. and larger.



lutely leak proof in a number of mills. As no contact is made between the two parts there is no need for replacement because of wear.

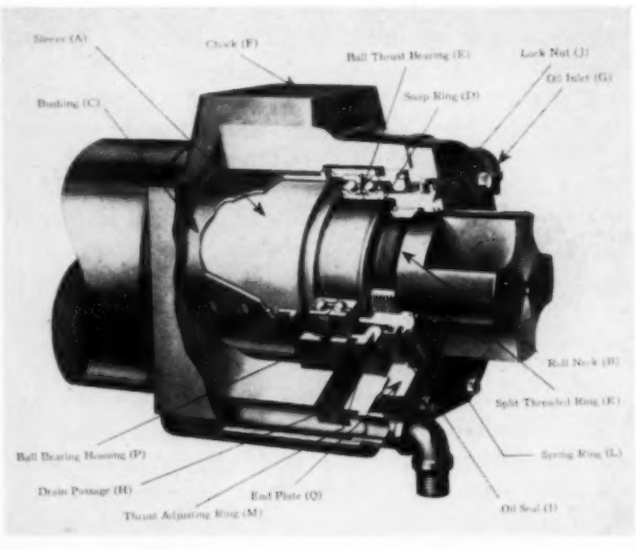
Most designs of these bearings use a sleeve packing, and all use bushing packing. Both of these are neoprene tubing, cut square on the ends and fitted snugly into their respective grooves to make continuous circles. The sleeve packing should be replaced frequently to prevent oil leakage from between the sleeve and roll-neck, and whenever a bearing is mounted on a new roll a careful check should be made to insure proper contact between the packing and the fillet of the roll-neck. The bushing packing is changed occasionally but, in some cases, will last for years.

The bearing is also equipped with a sealing element composed of a bronze ring, a boot and compression springs, for mills where a rolling lubricant is used. This seal is assembled with the bearing and the bronze ring rides the end of the roll barrel to prevent the entrance of the rolling lubricant into the bearing and subsequent contamination of the lubricating oil. The boot is made of neoprene for most mills, but alternately can be made of an asbestos fabric for mills where hot scale is encountered. These boots should be inspected at each roll change and replaced if burned or torn. On smaller bearings, rings of graphitar and synthetics have been used since they have less tendency to wear.

A further precaution against contamination is the installation of water deflectors. These are light-gage steel plates, made to rest on the top of the bottom bearings, curved to follow the contour of the inboard ends of the chocks, and are adjustable axially. When correctly positioned and tightened in place after the bottom roll has been properly located in the mill-housing, the inboard end of the deflector rests lightly against the end of the roll barrel and diverts the main flood of the mill lubricant from the sealing element. It is very important that the deflectors should not be abused or distorted or they will not serve their purpose.

If a wobbler cover cannot be used on a bearing, a conventional type of oil seal rides the lock nut to prevent contamination by the rolling lubricant. Regardless of where this type of seal is used, it is installed so that the sealing element points away from the mating part, and there is no possibility of having the seal doubled over.

Figure 2 — This bearing with ball thrust is used on bearings 18 in. and smaller.



FATIGUE

Fatigue is a rather common cause of failure in some types of roll-neck bearings. Our bearing is designed to operate at the relatively low unit pressure of 3,000 psi. The load is distributed over a large area, not concentrated in a few points. For this reason, failure due to compressive fatigue is impossible, and does not have to be considered in bearing maintenance.

LUBRICATION

The bearings are lubricated with a straight mineral oil delivered to the bearings at a constant temperature of 100 F, in predetermined amounts. The company has issued a simple set of specifications which covers the general characteristics of the oil. The viscosity is selected to meet the speed and load conditions of each particular installation. Our customers are at liberty to purchase the oil from any supplier who meets these specifications, which have been worked out with the co-operation of the refiners.

The automatic control of pressure, temperature and flow of oil removes all the speculation from the amount and frequency of lubrication. The constant temperature of the oil delivered to the bearings is of considerable advantage in maintaining roll shape, a feature that has been amply demonstrated in the rolling of aluminum foil down to 0.0007 in. at speeds ranging from 1,000 to 3,000 fpm. In the steel industry, there are tin mills operating on oil-film bearings at speeds up to 6,000 fpm. A permanent record is kept of the temperature of the oil leaving the finishing stand of a mill operating at 5,000 fpm where this temperature has not exceeded 130 F.

Should impurities find their way into the lubricating oil, they are very readily removed by the filter. Any rolling lubricant entering the system can be separated by heating and settling in one tank while the other tank is in service.

GRINDING

There are those, unfamiliar with these bearings, who think that the grinding of tapered neck rolls presents a problem in obtaining concentricity. This thought is dissipated on learning that aluminum foil is rolled to 0.0007 in. on mills equipped with these bearings using rolls from 10 to 21 in. diam, and rolling 0.005 in. on 30 in. diam rolls. The roll necks are designed to give adequate journal capacity for the grinding of any roll. There is no problem in the grinding of a tapered neck roll that does not exist in the grinding of a straight neck roll.

MAINTENANCE

Good maintenance is preventive as well as corrective, and should be the responsibility of both the oper-

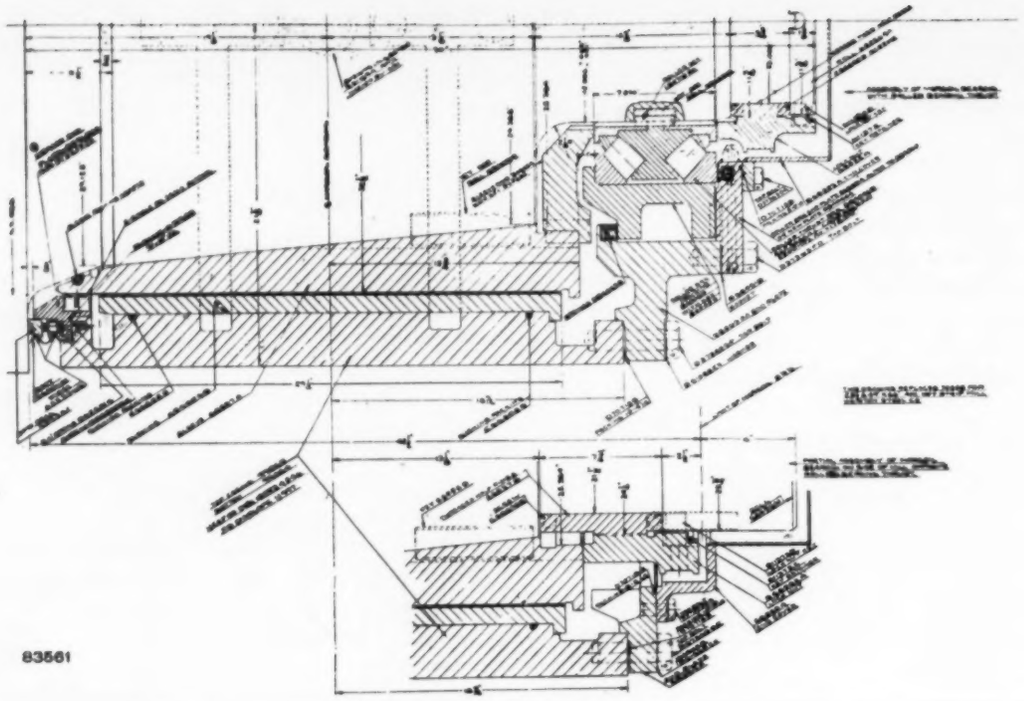


Figure 3—Section through bearing with oil seals on roll neck sleeve.

ating and mechanical departments. The results of good maintenance show up in weekly pay checks, profitable operations and improved morale. In its broader aspects, as applied to oil-film bearings, it is concerned with the proper mounting of the bearings in the mill-housings, the condition of the keeper-plates, clamps and latches; breaker blocks and rocker plates. Are these in good shape and are they doing their job? Oil-film means oil; is it being introduced to the bearings at the specified temperature in the proper quantity and clean? This involves the circulating system, its pumps, filter, cooler and valves and the automatic controls of temperature, pressure and volume. All these points are part of preventive maintenance and will go a long way in reducing corrective maintenance.

Intelligence, cleanliness and good facilities are the foundation of good maintenance. The care of the bearings should be delegated to men who appreciate good machinery and take pride in keeping it right. Do not keep changing your bearing men; experience is invaluable. A good location for the bearing shop, with adequate facilities, is of next importance. Bearings should never be disassembled or stored on the mill floor. A separate area, removed from operations, is desirable. If space is available in the roll shop, this would be an ideal location but, regardless of location, the bearing crew should work in a heated building and comfortable surroundings. The area should have ample storage space for all the spare working bearings and, since it is impossible to maintain the bearings properly without sufficient spare parts, storage space should be provided for these too. Oil and water seals, packings and other items can be stored in lockers and shelves. Besides this, there should be a good sized area for the mounting of bearings on the roll necks, and another for the complete dismantling and assembling of the bearings.

The ideal place to store a roll-neck bearing is on a roll neck. In the case of mills using large rolls there should be at least four Vee blocks, made of steel and lined with a suitable material that will not mark the roll bodies. Two newly ground rolls, fitted with their threaded half rings and having their neck keys on top, should occupy one pair of Vee blocks, while a pair of used rolls with their bearings would occupy the other pair of Vee blocks. As soon as possible, after taking a pair of rolls from the mill-housings, they should be turned in their bearings until the roll-neck keys are on top. This can be done with the chocks resting on the floor and by placing a steel pin in one of the holes in the periphery of the lock-nut and pulling with the crane on a cable looped around this pin, thus causing the roll to rotate. The rolls can then be set in the Vee blocks. After the used rolls and the bearings have been allowed to cool, the bearings should be transformed directly from the used rolls to the newly ground rolls without allowing the bearings to rest on the floor at all. Having the roll neck keys on top facilitates the entrance of the key in the sleeve keyway. There is no better means of keeping the bearings free from dirt.

Where many rolls are changed during the same mill shutdown, such as on rod and merchant bar mills, long benches should be furnished for the handling of from sixteen to twenty rolls. These benches should be made of steel plate having 2 in. angles welded around the perimeter to serve as troughs which can be drained to buckets under the benches. This arrangement simplifies housekeeping. Welded to the benches should be the desired number of Vee blocks, suitably lined and equally spaced along the benches.

INSPECTION

When a bearing is being transferred from one roll neck to another it is a good practice to examine the condition of the oil and water seals and the sleeve packing, and replace any of these parts as might be necessary. At the same time an inspection should be made

of the drain pocket of the chock. This normally contains nothing but lubricating oil but, if particles of foreign matter are found there, the bearing should be dismantled for a general inspection.

What should determine the schedule of inspection. This would be decided by experience and conditions. There are bearings operating in different types of mills in the same plant where one group may be inspected every three months while the others are only inspected annually. A good basis is three months with variations to suit conditions. In no case should consideration be given to dismantling the bearings every time they are removed from the rolls. Once the period of inspection has been determined, the cycle can be arranged so that a given number of bearings are dismantled each week or month, according to the number of bearings being used in the plant.

Although the bushing has a highly finished surface, when new this changes to a dull gray appearance caused by etching, which is typical of this bearing metal in service. This condition should give no concern since we know of no bearings that do not have this appearance, and hundreds of such bushings have been in service for more than fifteen years.

If a bushing is scored by scale or other foreign matter, the scoring can be lightly scraped over but, if it has been wiped by overloading, faulty lubrication or other factors, no attempt should be made to recondition it at the mill. Return the bushing to our plant where we have the facilities for reprocessing it.

Each time the bearings are dismantled they must be thoroughly cleaned before being reassembled. To clean the chock properly it should be immersed in a water tank having steam and water inlets, a drain, and an overflow to the sewer. Using a fair amount of degreaser in the water, the steam should be opened to boil the mill grease and scale off the chock. This can then be washed off through the overflow to the sewer before the chock is removed from the tank, and the final cleaning of the chock can be done with a solvent and high pressure air. Shallow pans should be furnished to contain solvents for the washing of all the other parts of the bearing.

The use of granular absorbents on the floor for greases and oils is general, but should be avoided in any area where bearings are being assembled. The high pressure air line, used for cleaning the bearings, inadvertently pointed at the floor covered with one of these absorbents would probably necessitate another cleaning of the bearing parts. The floor can be kept clean by spreading paper on it, and then having this thrown away after the bearings have been assembled.

When a new installation is made in a mill, the bearings are assembled under the supervision of our representative who gives the bearing crew detailed instruction on the care and maintenance of the bearings, and leaves with them the necessary detailed written instruction and prints. We will not dwell on the assembly of the bearings now other than to bring to your attention a few points of interest. First, all the bearing parts are interchangeable; any bushing fits any chock; any sleeve fits any bushing and so on. Second, there is no need for vernier or micrometer measurements. Third, no shims are used in any part of the bearing. Fourth, no force is used in the assembly of the various parts except the oil seals, which are a light drive fit in the chock or end plate, and the tightening of the tap bolts and the main lock-nut. Fifth, the radial and thrust bearings with the oil and water seals are assembled compactly for mounting on the roll-neck. This simplicity of design is one of the features of the bearing that has appealed to the rolling mill industry in general.

A lot of bearing trouble can be avoided by taking steps to correct faulty conditions before they go beyond working limits. In times past it was a common practice to make the radii of the screwdown and breaker-block alike. Now it is accepted that the radius of the concavity should be slightly greater than that of

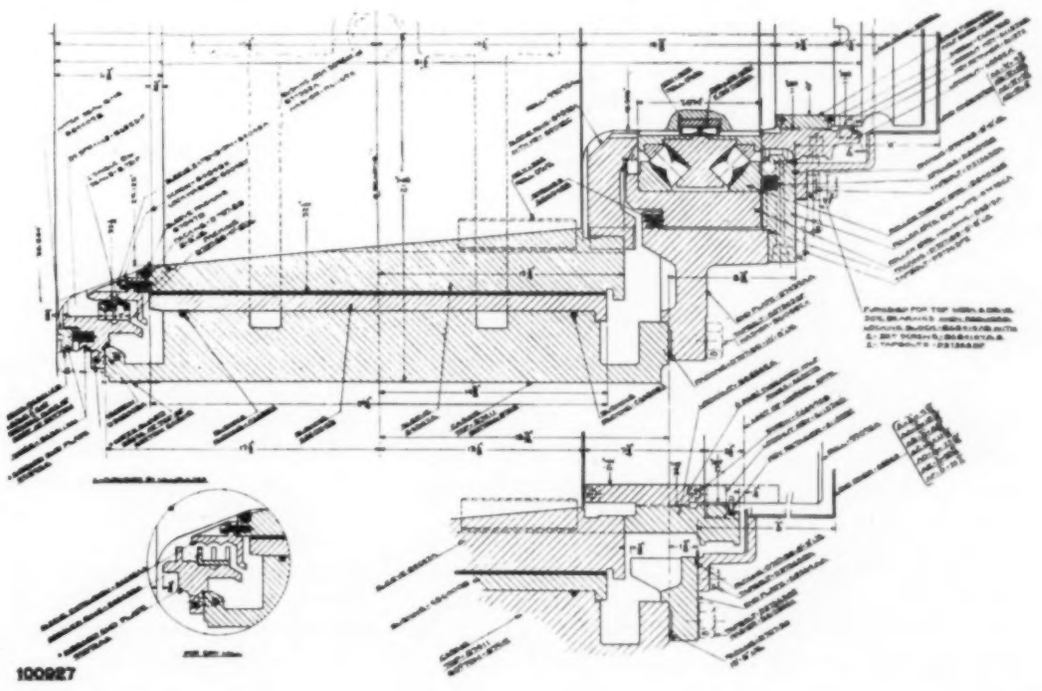


Figure 4 — Section through bearing using removable sleeve extension.

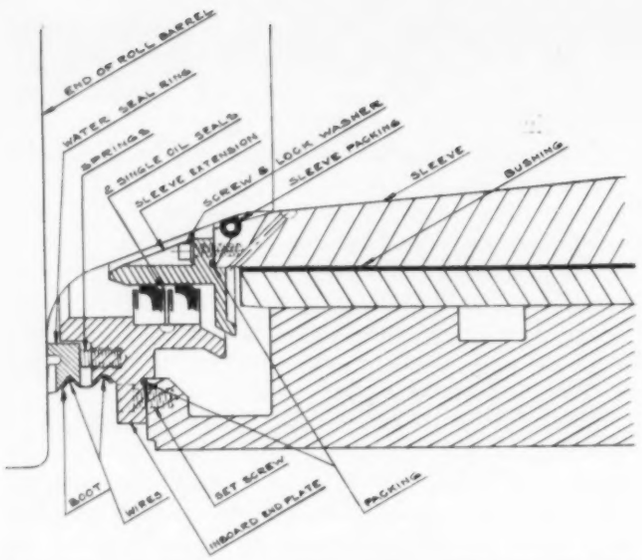


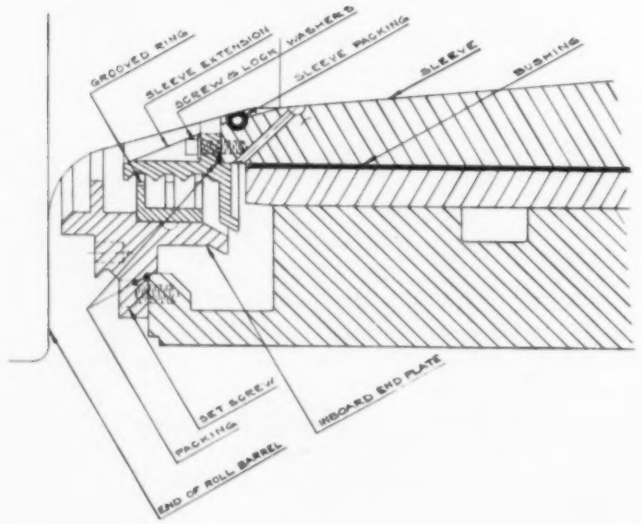
Figure 5 — Sectional view of sleeve extension with oil seals for wet mills.

the convexity. The object of this design is to achieve a ball and socket condition that will permit the top bearing to follow the deflection of the roll-neck. After a period of service, these parts can wear to the point where the contact between the two surfaces is so great that the traction of the one on the other can prevent the desired following of the roll deflection. This will cause concentration of load at the end of the bearing.

A rocket plate, making a theoretical line contact in the bottom of the mill-housing window, permits the bottom bearing to follow roll deflection. Broken or badly flattened rocker plates will also oppose the desired following of roll deflection and cause concentration of load at the end of the bearing.

Excessive thrust load in a mill can throw tremendous pressure on the thrust bearing and cause trouble, but this can be minimized with a little care. Mills are designed to operate with the axis of each roll parallel with its mate within reasonable tolerances. Operations cause wear of the mill-housing windows and the bearing chocks which, unfortunately, is not uniform. The amount of this wear that can be tolerated depends on the type of mill but, if it is allowed to progress beyond its limit, the attendant crossing of the rolls will set up a thrust in excess of the capacity of the thrust bearing. This situation is aggravated when a work roll is installed with unequal diameter necks. Offsetting the work rolls from the vertical centerline of the back-up rolls will help so long as the distances from the vertical centerlines of the rolls to the outsides of the chocks are within reasonable tolerances.

Figure 6 — Sectional view of sleeve extension and flingers with grooved ring for dry mills.



Years of operation may elapse, but eventually the bearing chocks must be reconditioned to reduce end thrust. This does not involve a lot of work if the chocks were equipped with wearing plates when new. These can be replaced with new wearing plates. If no wearing plates were furnished with the bearings, the chocks should be machined and equipped with them when the time for reconditioning comes. In either case care must be taken to hold the dimensions from the bores to the outsides of the chocks within the specified tolerances as shown on the drawing. The same care must be used when replacing wearing plates in the work-roll window of the back-up chocks.

The whole thrust of the mill is transmitted through the chock slots or lugs to the keeper-plates or clamps of the mill-housings. These parts are also subjected to wear that is not uniform, and they should be inspected and repaired lest the thrust of the mill be concentrated on one part.

Electric welding around a mill can be a source of trouble if the welder's arc is remote from his ground. Evidence of this can be found on the surfaces of roll necks and the bores of sleeves in the form of small pits. Wherever this pitting is found on machinery, it should be smoothed over. This pitting will be found in other parts of the mill machinery where there are minute clearances between two steel surfaces. Welders should be given specific instructions to place the ground as close to the arc as possible. In our own plant, we use magnetic grounds rather than the clamping type so that the ground can be attached to flat surfaces.

What is your cost per ton for bearing maintenance and replacement, and for lubrication? A careful record should be kept of the tonnages rolled on each bearing as well as the amount of lubricant used. The accounting system should show these figures at a glance, not only for the plant as a whole but for each individual mill.

The conditions I have tried to outline are ideal and you should not for a minute think that oil-film bearings are temperamental and are to be coddled. They are tough, rugged bearings that will stand anything you can throw at them, and I could tell some amusing stories about bad maintenance to prove my point. What I want to emphasize is the value of good maintenance. It is just a matter of dollars and cents. We have literally hundreds of bearings in the field that have been operating satisfactorily for more than fifteen years and the only maintenance, aside from labor, has been the replacing of oil and water seals, packings, a few threaded rings and lock-nuts, with an occasional bushing reconditioned or replaced, at moderate expense. The yearly replacement expense for well cared bearings is negligible.

DESIGN AND OPERATION OF

National Tube's Sintering Plant

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and
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. . . . although the sintering plant at National Works was designed for 500 tons capacity, it has averaged as high as 975 tons per day and 265 lb per sq ft of grate area . . . . good design and practice is thus indicated . . . .

▲ SINTERING in the steel industry is a process of agglomerating fine iron bearing materials into larger pieces suitable for blast furnace use. This is accomplished by heating the properly prepared materials to a partial fusion point while a strong air stream is drawn through these ingredients, thereby forming air cells or pockets throughout the entire mass. The principal purpose of sintering is the utilization of fine ores and flue dust which, because of their physical size, would otherwise be unsuitable for charging directly into the furnace.

Satisfactory sintering plant practice is dependent to a great extent on the design of the plant and auxiliary equipment and the type of raw materials used. Facilities for the unloading and storing of raw materials, proper screening, mixing and delivery of raw materials to the sintering machine uniformly and under constant control are vital to the successful production of a sinter of high quality. Conveyors, pug mills, fan, ignition furnace and control instruments properly designed and operated make possible the continuous production of sinter economically and with a minimum of delays.

That the sintering plant at National Works has been designed along these lines is indicated by the production record attained since the first sinter was made in September 1949. In spite of the many design and operating problems confronting National Tube Co. engineers, the 500-ton machine installed here has produced as much as 975 tons per day and 265 pounds per square foot of grate area per operating hour over a one-month period.

PLANT LAYOUT

The plant, which is an integral auxiliary of the blast furnace department, is located at the east end of the ore storage yard in a small L-shaped area restricted in size by installations previously erected in this area.

As is a frequent requirement at National Works, the lack of suitable space compelled the company architectural engineers to first make several alterations in the design of the structures surrounding the proposed sintering plant area. One bay, 20 feet in length and capable of holding four cars, was removed from the west end of the ore thaw house to make room for the storage bin building. The east end of the highline trestle was remodeled and extended for a distance of approximately 163 feet. In addition, a crossover switch was erected on this end of the trestle to allow the switching of cars from the north to the south tracks. However, at the present time this switch is very seldom used due to the fact that the material is too moist and compact to be dumped from railroad cars and to pass through the six-inch grating over the bins. It has been found much more satisfactory to dump all raw materials by using the car dumper.

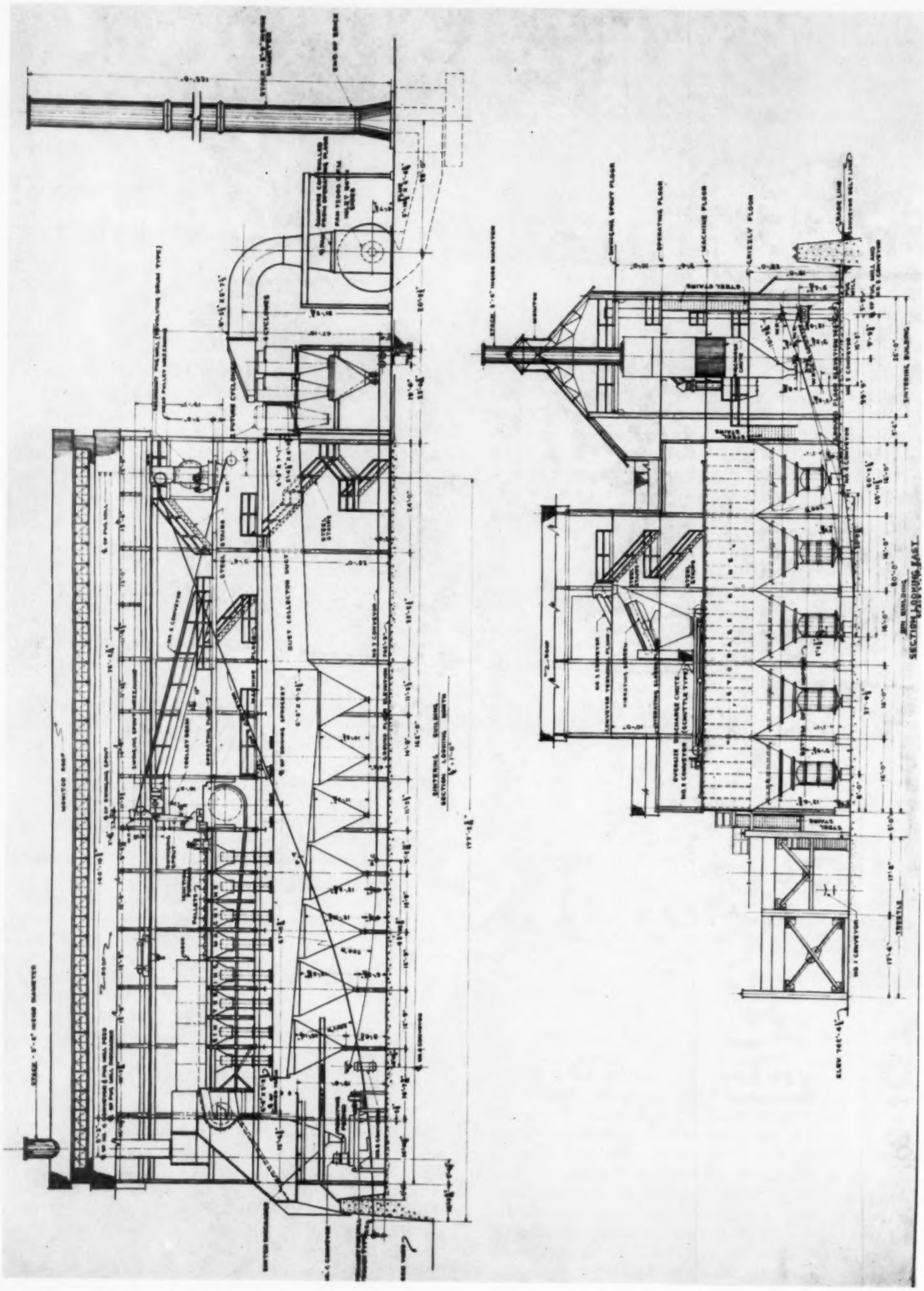
All designs for the sintering plant were drawn by the National Works' engineering staff in collaboration with the equipment manufacturers and steel fabricators. Work was started in December 1948 and plant operation began in September 1949. This was made possible by the close cooperation and coordination of the companies furnishing essential equipment and the prompt deliveries made by the various vendors.

The building is of steel framework with corrugated asbestos cement siding and roofing. A rather unique feature of the design is that continuous window sash has been installed along the entire length of the building on all floors plus the monitor. The purpose of this vast amount of window space is not primarily for lighting but for ventilation and overall improvement of working conditions.

The floor plans and general layout of the sintering building were dictated by the conveying belts as shown on Figure 1. However, some thought was also given to the idea of possible future expansion. The air duct installed at present between the sintering machine and the fan is sufficiently large to be used for a larger machine. Thus, to increase the nominal daily capacity from 500 to 900 tons, it is only necessary to lengthen the machine by 26 feet, install a larger fan motor, a new impeller for the present fan and add two cyclone dust collectors.

RAW MATERIALS

Flue dust from the four blast furnaces is carried in hopper cars to the 100-ton capacity traveling type car dumper where the dust is dumped into the eastern end of the ore yard near the sintering plant. In addition to the current flue dust from the blast furnaces, an even greater amount of stock flue dust is obtained from the two United States Steel Co. stock-piles located at Gascola and Briquette, Pa. Inasmuch as dust storage



space at the plant is limited to about 7000 tons of stock and 2500 tons of current dust and further, there are no dividing troughs in the yard, this occasionally presents the problem of keeping an ample stock pile of dust on hand.

The dust catchers and vortex-type separators at the blast furnaces are all equipped with pug mills for conditioning the flue dust. To further clean the blast furnace gas, six wet washers are employed; also, two electric precipitators are used in conjunction with the washers. The slurry from four of the washers flows to two 50-ft thickeners, and the resulting sludge is pumped into hopper cars. Slurry from the other washers and precipitators is pumped into a 90-ft thickener and from there to a 12-ft filter unit. Normal practice is to load hopper cars only half full with sludge from the thickeners or filter cake from the filter and then fill the remainder of the car with dry dust from the dust separators at the furnaces. This procedure has been found to absorb some of the excess moisture in the sludge, thus making it easier to dump and convey.

Materials for the sintering plant are reclaimed by a 12-ton ore bridge which discharges directly into the six receiving bins located on the east end of the trestle. After the dust is dumped into the ore yard by the car dumper, the ore bridge stocks it on the respective piles, and then, when required, the bridge transfers the dust from the stockpile to the receiving bins. It should be noted that while the above-mentioned procedure does not require any additional equipment for conveying the raw materials, it does, however, represent an extra burden on the already hard-pressed ore bridge which serves the blast furnace stockhouse as well as the sintering plant. During the four-month period from September through December 1950, the unavailability of the ore bridge was indirectly responsible for 36.4 per cent of the total delays at the sintering plant.

Finished sinter discharges into a small area storing about 5000 tons in the corner of the ore yard adjacent to the sintering plant building where it is in turn reclaimed by the ore bridge for use in the blast furnaces.

FLOWSHEET

Figure 2 shows a plan and cross section of the National Works' sintering plant.

The flow of raw materials starts with the receiving bins located on the highline trestle. Originally there were four of these bins, but two more were added later in order to obtain a better mixing of the materials. These six bins, each of 2150 cu ft capacity, lined with paving brick, are covered with a heavy six-inch steel grating. As shown on the plate, an equal number of bins are reserved for storing ore fines, current dust, and stock dust. Materials are fed from the bottom of the bins onto a 24-in. conveyor belt by means of rotary table feeders having diameters of 6 ft 6 in. These feeders are individually driven by 7.5-hp, constant-speed induction motors equipped with speed reducing units. The capacity of each table is approximately 75 tons per hour.

Figure 1 — Longitudinal section through bin and sintering ← building of 500-ton sintering plant.

Screening of the raw materials is accomplished by a single-deck gyrex-type vibrating machine from which plus ¾-inch materials are discharged through a chute directly to a pile in the ore yard where they are reclaimed for direct use in the blast furnaces.

The fine material passing through the vibrating screen drops onto a shuttle conveyor which distributes the screened material to the proper one of the five 3300 cu ft capacity storage bins located in the storage bin building. Like the six receiving bins on the trestle, three of the bins are lined with paving brick while the other two are made of special abrasion-resistant steel for handling coke breeze, scale, etc., should this material ever be stored in these bins. Discharge from the bins is by means of revolving table feeders, each individually driven by a 5-hp variable speed, d-c motor equipped with a speed reducing unit, shown on Figure 3. Each feeder table is 6 ft 6 in. in diam and has a rated capacity of about 40 tons per hour. Any combination of bins may be placed in operation discharging their burden upon the belt conveyors at one time. The amount of material flowing from each bin is controlled by means of a sliding gate on the bottom hopper; therefore, by discharging from two or more bins and controlling the flow of material, any mixture of materials with any percentage of each material can be obtained in the sinter mix. The speed of the conveying belts is constant at 170 fpm, but the flow of materials may be varied by means of a single gang-type rheostat which controls the speed of all the table feeders on the storage bins.

The 24-in. collecting belt which passes under the storage bin feeder tables conveys all material to a primary twin-shaft trough-type pug mill designed with a by-pass. This mill consists of a trough, 25 × 41 in., in which two sets of paddles rotate in opposite directions on parallel shafts. The two shafts are driven through an enclosed gear speed reduction unit. Due to the fact that the raw materials have such a high moisture content in their natural state, it has been found by experience that it is seldom necessary to pug the mixture with additional water at this stage in the system. At the present time a weightometer is in the process of being installed on the collecting belt for the purpose of keeping an accurate running check on the amount of raw materials entering the system.

Return fines, which are screenings from the finished sinter, and drippings from the windbox downcomers are added onto the top of the raw materials after the point where the weightometer is being installed. A series of 18-in. rubber belts convey the droppings to the main collecting belt as they fall from the windbox downcomers, and the return fines are fed onto the main belt by means of a 30 × 48 in. vibrating feeder. All the windbox downcomers are equipped with counterweighted flapper valves which are automatically opened to allow the accumulated drippings to drain onto the collecting belt. The amount of return fines going onto the collecting belt is controlled by a variable gate opening on the vibrating feeder which is set by the "feederman" on orders from the "burner operator."

All the raw materials, fines, and drippings are now conveyed on a 24-in. belt to the final pug mill, or "fluffer," which is a 5 × 9 ft revolving drum (revolving at seven rpm) equipped with a single shaft containing 32 paddles (revolving at 153 rpm). As the feed is mixed

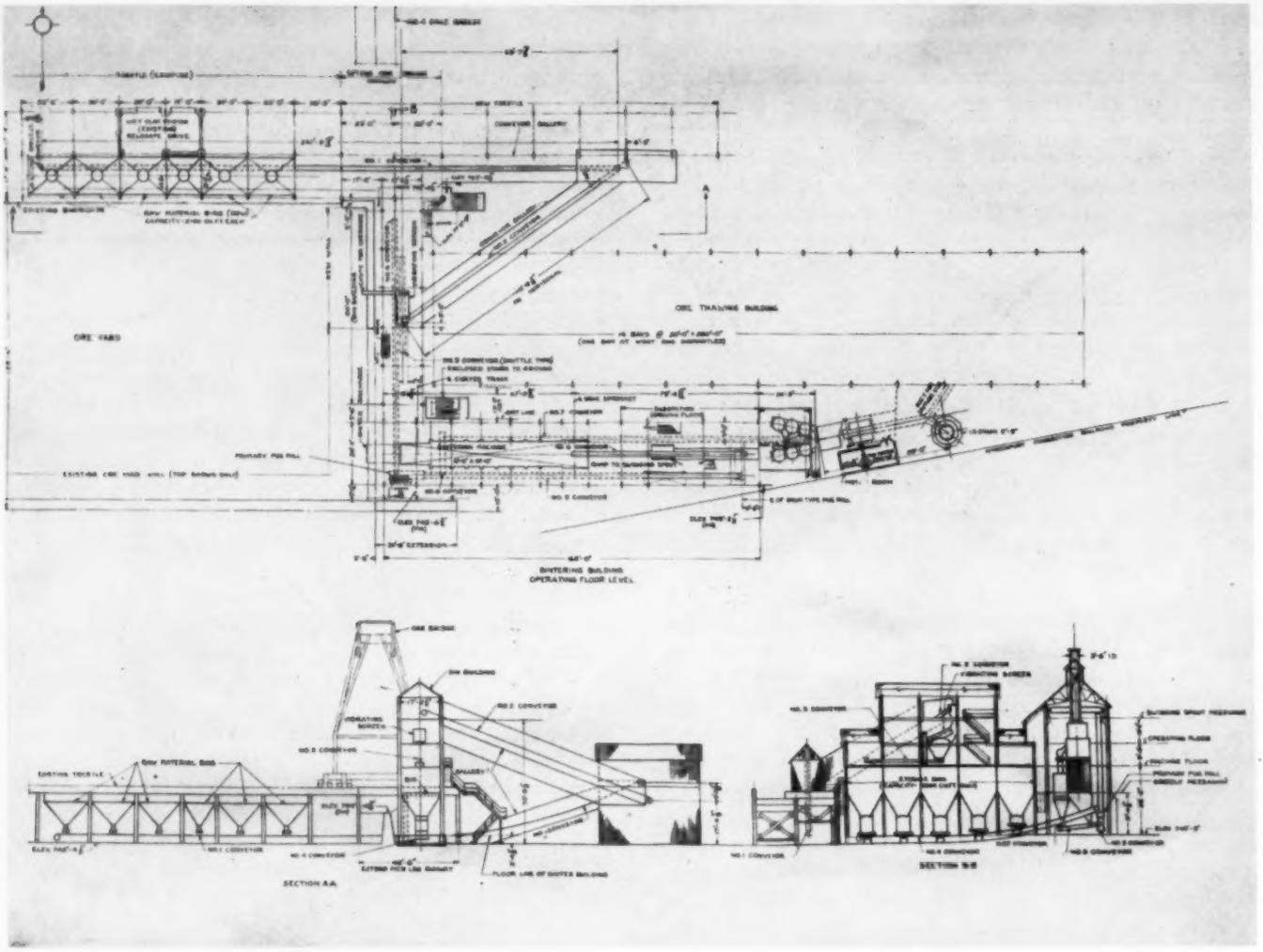


Figure 2 — General plan and cross sections through sintering plant at the National Works.

in the pug mill, water is added to produce the proper moisture content; in order to maintain a constant and steady flow of water, an electric flow meter and a booster pump, having a rating of 500 gpm at 75 psi at a 150-ft head, have been installed.

The raw mix is carried by a belt conveyor from the pug mill to the swinging spout which spreads the mix on the sintering machine to a maximum depth of 12 in., shown on Figure 4.

The swinging spout is of such design that the materials are deflected against the leveling plate of the sintering machine before they fall onto the grates, thus eliminating the packing effect which would occur should the materials drop directly from the spout to the traveling grates. The depth of the bed will vary, if conditions so require, in order to effect stronger structure in the sinter or a more complete burning of the sinter cake. As a further means of preventing packing of the bed and consequent loss of permeability, the feed is maintained at a height just above the level of the cutoff gate.

The bed passes under two sets of steel smoothing fingers, one set following the other, which smooth the surface for more even ignition. Ignition of the top of the bed is effected in the ignition furnace by a mixed coke-oven and natural gas flame applied as the bed reaches the first draft box. The furnace, which is of the brick-lined retort type, contains 36 small burners and applies a flame to the top of the bed for an average of 11 seconds. The necessary wind for proper combustion and projection of the gas flame in the ignition furnace is supplied by a turbo-blower, having a rating of 1000 cfm at 16 oz. From this point the sintering process proceeds by the application of suction as the pallets pass over the windboxes.

The sintering machine, shown on Figure 5 (this picture was taken during construction), is a continuous type, 72 in. wide and 51 ft in length and having a rated capacity of 500 tons per day. The 77 pallets of the machine pass over eight windboxes at a speed of 40 to 96 in. per min. The total length of the windbox is 45 ft, producing an effective grate area (i.e., area over the windboxes) of 270 sq ft. Six slotted-type malleable-iron grates were originally carried by each pallet, but experience has shown that 1¼ in. finger-type grate bars are much more efficient insofar as maintenance, longer life, and carrying features are concerned.

An automatic stopping device is provided that will stop the sintering machine in the event that a pallet gets out of step with the driving sprocket. It consists of a hooked arm that engages with an accidental space between two pallets to operate a limit switch which in turn breaks the driving motor electric circuit.

One unique feature of this machine is that the driving wheel on the feed end is somewhat larger in diam than

the semi-circular pallet track at the opposite end of the machine. This construction is designed to reduce the amount of strain, and consequent wear, on the pallet wheels and hubs.

In order to reduce the dust nuisance usually attendant on sintering operations, a steel plate hood has been installed over the final half of the machine. The suction through the bed thus tends to pull back the dust particles arising at the discharge end of the machine.

As the pallets pass over the windboxes, the draft required to complete the sintering operation is created by an 8-ft, 10-in. fan impeller driven by a 500-hp, 6600-v motor capable of exhausting 72,000 cfm or 9000 cfm per windbox at 25 in. water and 300 F. This fan is of the double inlet type having an impeller with radial blades. Each of the eight windbox sections are connected by a pipe to a duct running the full length of the machine. On the lower side of this duct are the dust catchers and from the bottom of each dust-catcher the fines are deposited on the drippings belt along with the fine dust from the cyclones by means of simple flapper valves designed with counterweights. Before reaching the fan impeller, the air is pulled through four cyclone cleaners which are arranged in parallel. These cyclones are lined with a mixture of lumnite cement and brick dust. From the cyclones, the gases are then exhausted to the atmosphere through a 125-ft steel stack of 5 ft 9 in. diam which is lined with fire-brick and paving brick to a height of about 10 ft above ground level.

At the discharge end of the machine, the sinter cake drops 4 ft onto an inclined plate, which partially breaks up the cake and distributes it over a stationary set of grizzly bars having a spacing of 1⅛ in. The sinter fines are thus screened into a brick lined hopper having a capacity of 320 cu ft from which they are fed at a predetermined rate onto the raw materials collecting belt.

The finished sinter product is then discharged into an area in the eastern end of the ore yard. A moderate amount of cooling water is sprayed onto the hot sinter as it lies in the yard so as to prevent damage to the bridge bucket and to insure the safety of the blast furnace operating personnel.

ELECTRICAL EQUIPMENT

Electrical equipment for the plant uses the unit-control scheme. This consists of master push button control panels for remote control of most drives; a central control center at the sintering machine containing most of the starters for the principal machines; and a unit load center substation for transforming the higher voltage primary distribution power to the desired lower voltage secondary.

Figure 6 shows a line diagram of the main power lines, the substation, and feeder circuits for the sintering plant. As shown by the diagram, power is supplied to the plant at 6600 v, 3 phase, and 25 cycles. The main fan employs the use of the full 6600 v, while a 500-kva transformer steps the primary voltage down to 220 v, 25 cycles for the auxiliary a-c equipment. With the exception of the sintering machine, storage bin feeder drives, and lights which are on a 250 v, d-c circuit, all equipment in the plant uses 220 v, 25 cycle a-c power which is distributed by means of three main feeder circuits.

The "burner operator" controls most of the equipment in the plant through the use of a central control panel adjacent to the sintering machine. At his station, the "burner" is able to employ two rheostats to regulate the speed of the sintering machine as well as the speed of the rotary feeder tables on the storage bins. Also, he has start-stop control over all the collecting belts, swinging spout, pug mills, ignition blower, main fan, and the return fines vibrator feeder.

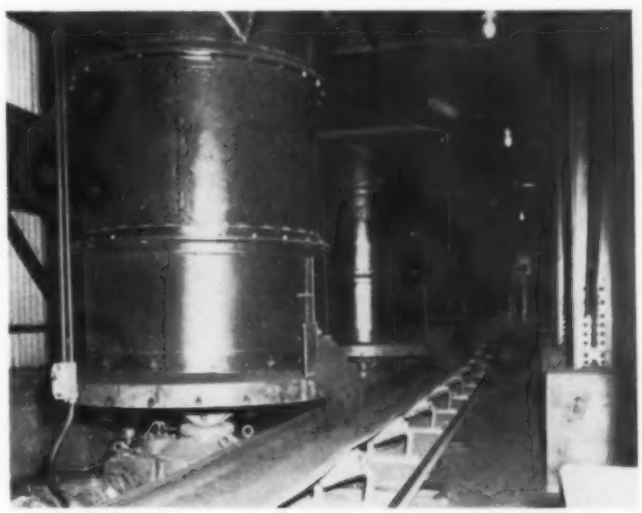
In addition, several instruments are installed on the main control panel to assist the "burner operator." These instruments consist of a tachometer for recording grate speed; a series of six U-tube manometers and thermocouples for indicating the suction and temperature, respectively, in No. 2, 4, 6 and 8 windboxes, in the air duct before the cyclone cleaners and in the main fan housing; an instrument to record the gas pressure in the ignition furnace; and an ammeter for indicating the current being drawn by the main fan.

The collecting belts, pug mills, and storage bin feeders are arranged in a sequence such that the stoppage of any one unit will cause all the equipment feeding the idle unit to stop automatically, thus avoiding any unnecessary spills.

In addition to the master control panel at the "burner operator's" station, there is a control panel at the "screenman's" station located at the shuttle conveyor which is used to fill the five storage bins. From this position, the "screenman" is able to operate the gyrex vibrating screen, the shuttle conveyor, and all the conveying belts which carry the raw materials from the receiving bins on the trestle to the storage bins; also, he is able to stop any or all of the rotary feeding tables of the receiving bins. Full control (i.e., starting and stopping) of these feeder tables is made possible by individual push-button switches located near the bottom hoppers of the receiving bins. This arrangement greatly facilitates the efficient transfer of materials from the receiving to the storage bins. The shuttle conveyor belt drive, vibrating screen, conveyor belts, and feeder tables in this series are also connected in a sequence for the sake of efficient operation.

Due to the need for close coordination required of all personnel in operating an efficient sinter plant, a two-

Figure 3 — Revolving table feeders are used to discharge material from the bins.



way communications system is installed throughout the building for the convenience of conveying messages and instructions.

The main fan motor is of the constant duty, squirrel-cage induction type, 6600 v, 500 hp, and 735 rpm. It is connected "across the line" and employs a full-voltage starter. By experience, we have found it best to operate the fan as much of the time as is possible. This is in contrast to our original policy of shutting off the fan whenever the sintering machine was stopped. Present practice is to stop the fan only when absolutely necessary; two motor-operated damper assemblies, remotely controlled from the sintering machine, permit cutting off the draft from the windboxes without stopping the fan. This policy has resulted in much more satisfactory fan motor operation.

SINTERING PRACTICE

Basically, the sintering practice at National Works has not changed during the 18 months of operation. Some experimenting has been done in regards to machine speed, depth of bed, and moisture in mix in an attempt to produce the best and most economical sinter, but the type of sinter mix used at present is substantially the same as that used in September 1949.

By experimentation it has been found that the highest quantity and quality of sinter is produced when using an 8-in. bed traveling at a speed of approximately 60 in. per min. However, while the depth of bed has been kept fairly constant, the grate speed has been varied considerably according to the type of raw material available—higher carbon or a very moist mixture naturally requires more time over the windboxes. An attempt is made to standardize the mix as near as possible in regards to carbon and moisture content, but this is not always a simple problem to solve at National Works where the supply and analysis of raw materials vary from day to day.

Actually, all features of sintering at National Works are controlled by the raw materials. For reasons of economics, the principal objective is to use all the current flue dust and filter cake produced by the blast furnace department and to make use of as much stock dust in addition as is possible. Normally, ore fines are added to the mix to decrease the percentage of carbon in the raw material mix.

During the three-month period ending January 31, 1951, the average raw material mix fed to the machine was: current flue dust, 30.5 per cent; stock flue dust, 61.6 per cent; ore fines, 5.1 per cent; and, filter cake, 2.8 per cent. It should be noted that this mix does not include figures of return fines or drippings; no weighings have ever been made of these additions to the mix, but the usual consumption is estimated at about 15 per cent of the total feed. Inasmuch as the sinter mix normally consists of practically all flue dust, it is necessary to add a relatively high percentage of return fines to the mix in order to produce the desired degree of porosity required for good sintering operations. The idea of sintering a greater percentage of ore fines has not been completely dismissed, but this will become a reality only after the present supply of stock flue dust is depleted.

Inasmuch as standard tests for measuring sinter quality are only in the development stage at the present time, it is rather difficult to make a statement regarding the product. Under actual operating conditions, however, the sinter has proved to be very satisfactory. It is strong, porous, and of a desirable size. Sieve analyses have shown that approximately 85 per cent of the sinter is plus ⅛ in., 40 per cent is plus ½ in., and only 8.5 per cent is plus 2 in.

MAINTENANCE

Due to the abrasive nature of the materials handled in the sintering plant, the custom has been to reserve one turn per week for repair work. In addition to changing paddles in the pug mills, changing pallets and grates, inspecting the fan, and doing other necessary repairs which would otherwise cause a shutdown, a crew of laborers is assigned the task of cleaning beneath all the conveyor belts. This policy of shutting down one turn per week has proved in the past to produce very beneficial and economical results.

Figure 4 — A swinging spout spreads the mix on the sintering machine.

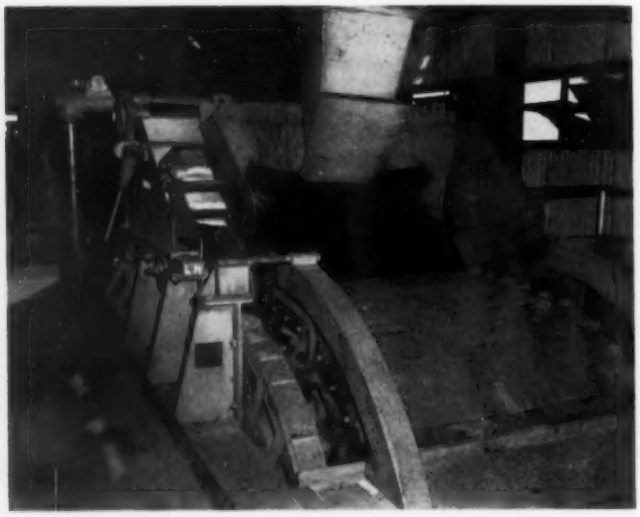


Figure 5 — The sintering machine is 51 ft long and 72 in. wide. View shown was taken while the machine was under construction.

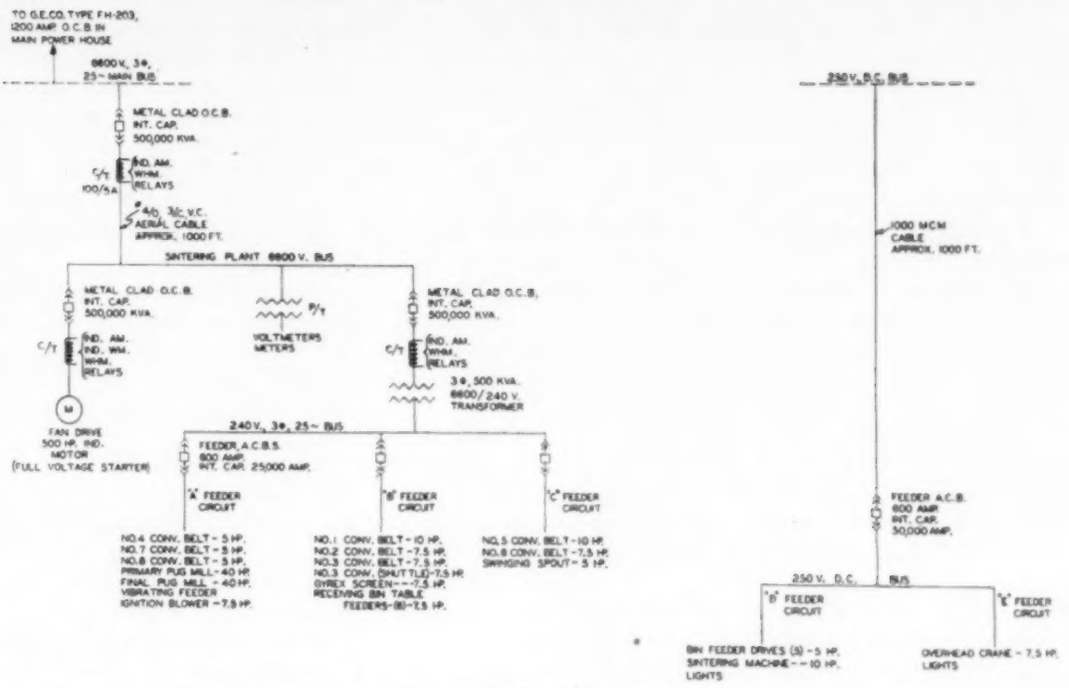

TO G.E.CO. TYPE FH-203, 1200 AMP O.C.B. IN MAIN POWER HOUSE
6600 V., 3φ, 25~ MAIN BUS
METAL CLAD O.C.B. INT. CAP. 500,000 KVA.
IND. AM. WHM. RELAYS
C/T 100/5A
4/0 3C. V.C. AERIAL CABLE APPROX. 1000 FT.
SINTERING PLANT 6600 V. BUS
METAL CLAD O.C.B. INT. CAP. 500,000 KVA.
P/T
VOLTMETERS METERS
C/T
IND. AM. IND. WM. WHM. RELAYS
METAL CLAD O.C.B. INT. CAP. 500,000 KVA.
IND. AM. WHM. RELAYS
3φ, 500 KVA. 6600/240 V. TRANSFORMER
FAN DRIVE 500 HP. IND. MOTOR (FULL VOLTAGE STARTER)
240 V., 3φ, 25~ BUS
FEEDER A.C.B.S. 600 AMP. INT. CAP. 25000 AMP.
'A' FEEDER CIRCUIT
'B' FEEDER CIRCUIT
'C' FEEDER CIRCUIT
NO.4 CONV. BELT - 5 HP.
NO.7 CONV. BELT - 5 HP.
NO.8 CONV. BELT - 5 HP.
PRIMARY PUG MILL - 40 HP.
FINAL PUG MILL - 40 HP.
VIBRATING FEEDER
IGNITION BLOWER - 7.5 HP.
NO.1 CONV. BELT - 10 HP.
NO.2 CONV. BELT - 7.5 HP.
NO.3 CONV. BELT - 7.5 HP.
NO.3 CONV. (SHUTTLE) - 7.5 HP.
GYREX SCREEN - - 7.5 HP.
RECEIVING BIN TABLE FEEDERS - (8) - 2.5 HP.
NO.5 CONV. BELT - 10 HP.
NO.6 CONV. BELT - 7.5 HP.
SWINGING SPOUT - 5 HP.
250 V. D.C. BUS
1000 M.C.M. CABLE APPROX. 1000 FT.
FEEDER A.C.B. 600 AMP. INT. CAP. 50,000 AMP.
250 V. D.C. BUS
'B' FEEDER CIRCUIT
'A' FEEDER CIRCUIT
BIN FEEDER DRIVES (5) - 5 HP. SINTERING MACHINE - - 10 HP. LIGHTS
OVERHEAD CRANE - 7.5 HP. LIGHTS

Figure 6 — Line diagram shows main power lines, substation and feeder circuits.

During the normal operating period, a millwright is employed on every day-turn to do the necessary lubrication and any other minor maintenance work which may arise. This too has proved to be a good policy as shown by the fact that relatively few shutdowns have resulted due to mechanical failures. Most of the delay time is caused by materials and material handling problems.

The principal concern in regard to maintenance has been the excessive number of paddles required to keep the pug mills in good operating condition. Various types of materials have been tried, including abrasion-resistant steel, hard-surfaced low-carbon boiler plate, oak, etc., but the most satisfactory paddles have been found to be made from common boiler-plate. This same material, boiler plate, is also used almost exclusively for making chutes and troughs throughout the plant.

In order to facilitate repair work on the sintering machine, a two-ton electric traveling crane, with enough cable to permit handling of equipment from the ground floor to the operating floor, is installed directly over the machine.

FUTURE CONSIDERATIONS

Inasmuch as no standard tests for sinter have ever been devised by the iron and steel industry, the blast furnace department is making a thorough investigation into possible reducibility, strength, porosity, and other beneficial tests for studying the sintered product. Until such time as laboratory or experimental tests prove otherwise, no change in operations, aimed at changed or improved product, is contemplated.

In an attempt to control the free dust, and thus improve working conditions within the sintering plant, a patented process is being considered for the future, which consists of breaking the crust of the bed with heavy chains just beyond the ignition burner and introducing additional moisture to the mix by means of a single steam and two water sprays located at strategic points along the length of the machine. It is expected that this process will maintain a constant moisture content of the unsintered material within the optimum range of 14 to 17 per cent and thus reduce the free dust which would otherwise be drawn through the grates when the moisture content drops below the optimum. In addition to controlling the free dust, more uniform combustion of the sintered material should result from this innovation, producing a more completely sintered product.

Some consideration is also being given to the installation of an electrically heated screen on the vibrating unit. Due to the fact that the raw materials available are excessively moist in their natural state, it is felt that a heated screen will avoid the plugging of this screen and increase screening efficiency.

DISCUSSION

PRESENTED BY

A. G. ERICSON, Chief Engineer, Homestead Works, United States Steel Co., Munhall, Pa.

E. O. AUSTERMILLER, Chief Engineer, National Tube Co., McKeesport, Pa.

HARRY ROBB, District Manager, Timken Roller Bearing Co., Pittsburgh, Pa.

A. G. Ericson: It was mentioned that production had been running over 900 tons in 24 hours, with the machine designed for 500 tons. As to the product mix, was it a heavy ore charge at that time when production was 900 tons?

E. O. Austermiller: It was about ten per cent ore charge.

A. G. Ericson: That is a remarkable performance, when you start with a machine designed for 500 tons normal dust mix, and with only ten per cent ore getting

up to 900 tons. We are very much interested in the capacity of sintering machines and the output that we can get from them. We think that by increasing the ore mix we should be able to greatly increase the capacity. At Carrie Furnaces, we have a 1500-ton machine, and have been running lately at the rated capacity of 1500 tons. We are running an ore mix of about 30 per cent.

During the winter how did you get your flue dust through your screen over the bins? That was a source of trouble for us and I wonder how you were able to solve that problem at McKeesport?

E. O. Austermiller: That is a pretty hard problem to solve. About the only way you can do is dig it through.

A. G. Ericson: We had air lances and a couple of men there working day and night to get the charge through the vibrating feeders onto the No. 1 belt, and it is quite a job. In fact we had to raise our screen up over the hopper about six to eight feet in order to get our charge through.

Another question I have concerns heat to the screens. Some of our ores are very wet and sticky; they are just like clay and stick to the screens. We do not have any heated screens yet, and that is one subject that we would like to be enlightened on. Our screen is six by twelve feet. The openings are $\frac{5}{8}$ by $3\frac{1}{4}$ or $3\frac{1}{2}$ in., and the $3\frac{1}{2}$ in. dimension is in the direction of material flow. I was wondering if the screening would be more effective if we reversed the screen so that the $\frac{5}{8}$ in. opening would be in the direction of flow. I understand that some of the foundry sand producers have found it to their advantage to turn the screen 90 degrees from that recommended by the screen manufacturers. Have you experienced anything like that?

E. O. Austermiller: No, I would say that ours is more longitudinal also, and we are experiencing at times sticking on the screen, and that is the reason we are contemplating going to some heat on that screen, on account of the moisture.

A. G. Ericson: Would you use gas heat or electric?

E. O. Austermiller: We are thinking about going to electric heat on it.

Harry Robb: I would like to have the answer to two questions relating to pallet wheels. I would like to know what type of seal you use; is it labyrinth or rubbing type, and also how frequently do you lubricate? Is it once a week when you shut down, or more frequently?

E. O. Austermiller: The type of seal used is known as "wind seal bars." These bars are $\frac{3}{4}$ in. cold rolled steel which fit into machine slots in each side of each pallet to form a wind seal. They are held in place by two pins on each seal bar which allow sufficient freedom of movement to slide freely along the pallet truck.

A. G. Ericson: At the filters, how do you get the filter cake from the filter to your belt? We have had a lot of trouble with our screw type conveyor, it plugs up and nothing goes through.

E. O. Austermiller: This filter peels right off and drops right down into a car. We do not go to any belt.

A. G. Ericson: How do you cool your sinter? Do you have an air cooling system or do you dump it into a water-filled pit?

E. O. Austermiller: We just dump it into the ore yard and it is cooled by water.

Announcing

1952 ANNUAL AISE CONVENTION

AND

IRON AND STEEL EXPOSITION

CLEVELAND PUBLIC AUDITORIUM

CLEVELAND, OHIO

SEPTEMBER 30, OCTOBER 1, 2 AND 3

CURRENT AISE DISTRICT SECTION MEETING NOTICES

BIRMINGHAM SECTION

Monday, November 26, 1951 — Dinner 7:00 P.M.; Meeting 8:00 P.M.

"Modern Applications of Hydraulics," by J. R. Carlson, General Manager of Sales, Berry Div., Oliver Iron and Steel Corp., Pittsburgh, Pa.

Thomas Jefferson Hotel, Birmingham, Ala.

▲

BUFFALO SECTION

Tuesday, November 13, 1951 — Dinner 6:30 P.M.; Meeting 8:00 P.M.

"The Heating of Steel in a Specialty Mill," by Laurence F. Van Mater, Metallurgist, Steel Mills, Simonds Saw & Steel Co., Lockport, N. Y.

"Advancement of Soaking Pits," by Don McGeary, General Foreman, Soaking Pit, The Steel Co. of Canada, Ltd., Hamilton, Ont., Canada.

Sheraton Hotel, 715 Delaware Ave., Buffalo, N. Y.

▲

CHICAGO SECTION

Thursday, November 8, 1951 — Dinner 7:00 P.M.; Meeting 8:00 P.M.

"Centrifugal Blowers and Compressors for Steel Mill Service," by R. N. Williams, Manager Blower Dept., Elliott Co., Jeannette, Pa.

Phil Smidt's Restaurant, 1205 North Calumet Ave., Chicago, Ill.

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CLEVELAND SECTION

Monday, November 19, 1951 at Cleveland, Ohio — Dinner 6:30 P.M.; Meeting 8:00 P.M.

Tuesday, November 20, 1951 at Youngstown, Ohio — Dinner 6:30 P.M.; Meeting 8:00 P.M.

"Industrial Applications of Ultrasonics," by Frank Massa, Director, Massa Laboratories, Inc., Hingham, Mass.

Cleveland — Allerton Hotel, Cleveland, Ohio.

Youngstown — El Rio Club, Youngstown-Warren Rd., Route 422, Youngstown, Ohio.

DETROIT SECTION

Tuesday, November 13, 1951 — Dinner 7:00 P.M.; Meeting 8:00 P.M.

"OLD TIMERS' NIGHT"

"The Old Timer and the Young Engineer," by L. F. Coffin, Supt. Mechanical Dept., Bethlehem Steel Co., Sparrows Point, Baltimore, Md.

"Production Characteristics of the Open Hearth," by H. F. Lesso, Open Hearth Control Metallurgist, Great Lakes Steel Corp., Ecorse, Mich.

Dearborn Inn, Dearborn, Mich.

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PHILADELPHIA SECTION

Saturday, November 3, 1951 — Dinner 6:00 P.M.; Meeting 7:00 P.M.

"Experiences with Castable and Rammed Refractories," by J. E. Deegan, Ceramic Engineer, Bethlehem Steel Co., Steelton, Pa.

"Rammed Castable Refractories, Their Application and Service for Steel Mills," by Robert R. Fayles, Fuel Engineer, Lukens Steel Co., Coatesville, Pa.

"Experiences with Refractory Concrete," by Wm. N. Horko, Furnace Engineer, Henry Disston & Sons Co., Philadelphia, Pa.

"Advantages of Rammed and Cast Refractories for Steel Plant Use," by R. E. Wolfensperger, Refractory Engineer, Combustion Div., Bethlehem Steel Co., Bethlehem, Pa.

Engineers' Club, 1317 Spruce St., Philadelphia, Pa.

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PITTSBURGH SECTION

Monday, November 19, 1951 — Dinner 7:00 P.M.; Meeting 8:00 P.M.

"Long Range Look at Engineering Manpower," by H. N. Muller, Jr., Assistant to Vice President, Westinghouse Electric Corp.

"Industrial Training for Professional Development," by Guy Kleis, Manager, Educational Dept., Westinghouse Electric Corp.

University Club, University Place, Pittsburgh, Pa.

PICTORIAL REVIEW 1951 AISE CONVENTION

HOTEL SHERMAN - CHICAGO, ILLINOIS

OCTOBER 1, 2, 3 AND 4

Returning to Chicago after an eleven year absence, the Association of Iron and Steel Engineers held one of its most successful conventions at the Hotel Sherman. Registration (1) totaled 2296 for the four-day session. As customary each morning at 7:45 a.m., the authors and chairmen met at breakfast to assure a smooth running convention. On Monday, October 1, the following were seen at breakfast: electrical session (2) — R. W. Graham, Bethlehem Steel Co., E. E. Vonada, Reliance Electric and Engineering Co., John C. Lebens, Bussmann Manufacturing Co., and Carleton Lord, United States Steel Co. Combustion session (3) — E. A. Hawk, Tennessee Coal, Iron and Railroad Co., Harvey Krouse, Fischer and Porter Co., C. W. Bruce, Republic Steel Corp., and W. B. Wilson, General Electric Co. Mechanical Session (4) — J. J. Healy, Armco Steel Corp., M. V. Herasimchuk, Bethlehem Steel Co., H. R. Knust, Bethlehem Steel Co., K. A. Blom, Republic Steel Corp., and L. F. Coffin, Bethlehem Steel Co. Operating practice session (5) — B. R. Small, Aluminum Co. of America, A. K. Blough, Republic Steel Corp., H. F. Lesso, Great Lakes Steel Corp., and W. E. Hart, Ford Motor Co.

On Tuesday morning, October 2, two simultaneous technical sessions were held. Participating in the electrical session (6) were: E. L. Blankenbeker, Heyl and Patterson, Inc., W. R. Wickerham and G. E. Mathias, Westinghouse Electric Corp., and J. J. Stolz, Tool Steel Gear and Pinion Co.; in the rolling mill session (7) were, sitting, A. H. Griffiths, Sheffield Steel Corp., Andrew Wilson, United Engineering and Foundry Co., and, standing, W. F. Hoffman, Jones and Laughlin Steel Corp., and J. J. Booth, U. S. Steel Co.

An inspection trip (8) to the Gary Sheet and Tin division of Gary works of U. S. Steel Co. was held Tuesday afternoon. Twenty-three buses transported the steel men from Hotel Sherman to Gary, Ind.

Wednesday, October 3, attendance at the technical sessions continued at a peak indicating the keen interest the steel men had in the convention program. At the lubrication session (9) were seen: F. L. Gary, U. S. Steel Co., Andrew Cichelli, Bethlehem Steel Co., C. H. Layton, American Chain and Cable Co., Inc., and C. R. Burton, Oliver Iron Mining Co., and J. A. Rigby, Brooks Oil Co. In the Combustion Session (10) E. H. Cauger and J. C. Stamm, Jr., Wheeling Steel Corp., R. A. Lambert, Jones and Laughlin Steel Corp., G. J. Gockstetter, Republic Steel Corp., and A. F. Kritscher, National Tube Co.

Wednesday afternoon the standardization session (11) included, sitting: J. J. Booth, U. S. Steel Co., L. J. Gould, Bethlehem Steel Co., E. L. Anderson, Bethlehem Steel Co., and, standing, J. E. Bodoh, U. S. Steel Co., A. H. Arbogast, Bethlehem Steel Co., and C. G. Dimitt, U. S. Steel Co. Concurrently at an operating practice session (12) were seen R. M. Reichel, Hydropress, Inc., A. F. Kritscher, National Tube Co., and L. K. Schuster, Heintz Manufacturing Co.

At the annual banquet, Wednesday evening, October 3, the AISE Kelly first and second prize awards were presented to (13) E. T. Lorig and C. G. Hogberg, both of U. S. Steel Co. Third prize was posthumously awarded to Frank Janecek, Republic Steel Corp., who died in September, 1950.

H. W. Johnson, vice president, Inland Steel Co., is seen at the reception for the speakers table with G. T. Avery, president, Acme Steel Co., and W. Sykes, president, Inland Steel Co. Mr. Johnson delivered a stirring talk at the general session of the convention Wednesday afternoon. The complete text of his address is found on page 122 of this issue. I. N. Tull, Republic Steel Corp., who was elected AISE president for 1952, is seen with J. H. Vohr, U. S. Steel Co., as they sign the AISE Kelly Awards.

On Thursday, October 4, in the electrical session (16) were seen: G. B. Scheer, Kaiser Industries, Inc., M. B. Antrim, Lukens Steel Co., H. G. Heath, Pittsburgh Lectromelt Furnace Corp., W. A. Perry, Inland Steel Co., and D. L. Beeman, General Electric Co.

In the afternoon the operating practice session (17) included: R. C. Brunner and John Wargo, Jones and Laughlin Steel Corp., Leonard Larson, Republic Steel Corp., S. S. Johnston, Weirton Steel Co., and M. D. Stone, United Engineering and Foundry Co.

Actively assisting in the general arrangements for the 1951 convention was the Chicago district section secretary, Arthur J. Whitcomb, Freyn Engineering department of Koppers Co., Inc., who is seen with H. W. Neblett, Inland Steel Co., and J. W. Corey, Reliance Electric and Engineering Co.

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PROBLEMS IN STEEL PLANT ADMINISTRATION

H. W. JOHNSON

By H. W. JOHNSON
Vice President
Inland Steel Co.
Chicago, Ill.

. . . . feature address presented at 1951 Annual Convention of Association of Iron and Steel Engineers, General Session, Hotel Sherman, Chicago, Ill. October 3, 1951 . . . .

▲ I AM very pleased with this opportunity to appear before the Association of Iron and Steel Engineers and be a part of the very stimulating program which is being presented here in Chicago. I should like to congratulate all of you people who have had to do with the development of this organization because it has contributed greatly to the growth of the iron and steel industry. I had the opportunity of appearing before this organization once before at which time I presented a paper on blast furnaces. (Editor's Note:—"Details of Design, No. 5 Blast Furnace Inland Steel Co.", Proceedings AISE, 1940, p 166.) I was quite comfortable in doing that because I was talking in a field in which I had some knowledge. Today I am quite apologetic because I do not feel on such firm ground. It was suggested that I talk to you for a few minutes on "Training in Steel Plants," or "Problems in Steel Plant Administration." I will use the latter as the title for my comments.

You have a perfect right at this time to question whether it is worth your while to listen to my comments on that subject and you also have the right to question whether this is a proper subject for discussion at this engineering convention. At the conclusion of my remarks, I shall not be disturbed if there is any doubt in your minds as to my qualifications to talk on this subject; however, I shall be most happy if you believe it is correct that this subject should be discussed here. I think it is a fit subject for discussion at your engineering convention, not only at this particular session, but at many sessions in the future as at some sessions in the past.

I know the subject of steel plant administration is not of special interest to this group; however, the subject of training of personnel in the organization is of much more interest. I would like to convince you that the latter is only one part of the former; it is difficult to discuss the two separately. While training is of immediate interest and we accept it as one of our problems, we should broaden our concept and realize that it is part of the whole problem of administration.

Let me illustrate. Just what do we mean by training? By training, we certainly mean the preparation of some individual or individuals to do a job. This suggests, obviously, that the first thing we need to do is get acquainted with what the job is because we cannot train someone for a job until we know what we are training him for. Next, there is the problem of the person to train, which means someone has to be selected to be trained, which gets us to the problem of the selection of the individual, and then finally, the training itself.

At first glance the problems of describing the job, selecting the person for the job, and training him sound quite simple, and, in themselves constitute a training program, but actually they can become quite complex because they lead us into the general problems of administration. In order to define a job someone has to have a pretty good idea of exactly what the job is. To do this thoroughly requires that the organizational structure be designed, and then the various jobs developed in order to accomplish most efficiently the ends that are desired.

This requires careful planning and leads one into all of the problems of organizational structure that we hear referred to so often in all the many, many textbooks. There must be consideration of line and staff capacity of these individuals, consideration of the levels

of authorities, the span of command, etc. I do not expect to talk about these now, but we all recognize that it is the development of proper organizational structures which result in situations where people function happily and effectively because they know exactly what their jobs are and so can work without frustration where there is a minimum possibility of friction, of playing politics, empire building, and similar commonly known difficulties.

Now we as operators and engineers are inclined to avoid much of this discussion on administration and organization because, as much as we hate to admit it, the fact is that it is rather terrifying. It is terrifying because we have not been exposed to it in an academic way, and because we do not know the language, we do not feel capable of coping with these many volumes prepared by academic persons. The point I hope to develop is that there needs to be more awareness on the part of all of us that this is a real field of development, that it is growing, that it is going to continue to grow, and that we should participate in its development.

I had an experience in the late 1920's which may be illustrative of a similar situation. Along about that time the Bureau of Mines did much effective work in studying iron and steelmaking, and they, together with others, brought to our attention the importance of the physical chemistry of these processes. I had never had physical chemistry in college and I found myself unable to understand the discussions which were taking place, and finally found I was avoiding all this new information. I had the opportunity to enroll in a university course in physical chemistry and became acquainted with a textbook on the subject and obtained a reasonable understanding of the principles that were involved. This limited amount of knowledge proved sufficient for me to appreciate and understand these new concepts. It was just enough to allow me to grow with this new field.

To the average technically trained engineer, the abstract discussions of the business administration people with their abstract generalizations have so little meaning that he does not feel they belong in his world. However, once he learns the particular terminology and principles, it is immediately apparent to him that he can apply them to his field in the same way the specialized expert does, and this understanding of the principles and terminology gives him the added understanding he needs to be a more effective administrator.

Now let us consider the question as to whether or not this is a proper place to be carrying on this discussion. Obviously I think it is, and I have two unrelated reasons why I do.

First, the men of this Association of Iron and Steel Engineers have done more than any other group in the steel industry to bring this problem on. Just as the agrarian civilization which existed a hundred years ago was extremely simple, and the number of laws and regulations required to govern that civilization were at a minimum, so also was the operation of making iron and steel quite simple, not a century ago but just a few decades ago. As civilization has advanced, it has become more complicated and has required much more regulation and law in order to function smoothly. So also has the operation of steel plants become more complicated, necessitating refinements in methods in order that it also can function smoothly.

This point is brought home very clearly by the obvious illustration of rolling sheets on the old hand sheet mills in comparison to the production of sheets on the present hot and cold strip mills. It is true that the men on the old sheet mills worked much harder, but the problems of organization, administration and control were simple. Each mill was a separate unit with its small crew under the supervision of a roller. If a man failed to show, another man from the labor gang could be shoved in and the work could go on. An error in judgment, or the failure of a person could spoil only a few sheets and there was little chance of any serious breakdown of the entire unit. Contrast that to the operation of a modern strip mill where a carefully planned crew is essential. Here every man of a group of several hundred must be trained to do his part, and everyone of the many complicated steps must be covered and coordinated, and they must function completely if the strip is to be rolled. If any one person of these several hundred should fail, large quantities of scrap are produced, or maybe the whole process stops.

We recently started up a continuous galvanizing line, and we are still running a few of the old conventional pots. The two processes are so different that even comparison between the two is difficult. It is amazing what a crude piece of equipment the conventional galvanizing pot is, simple to build, simple and safe to operate. In contrast, the continuous galvanizing line is a very intricate piece of equipment — a series of large units of precise design, delicately formed to function together properly. When all of these component parts do function together properly, in speeds and temperatures, in gas pressures and analysis, and strip tensions, a good product is produced. But when any single one of them is out of adjustment, the whole process may not function at all, and worse than that, serious damage can result that not only is costly but is hazardous as well.

Similar vast differences are observable in a comparison of the modern day open hearths with their complement of instruments for regulating temperatures, pressures, and drafts, in comparison to the simple units of thirty years ago, or a hot dipped tin pot versus an electrolytic line. This is all obvious to each of you. What is not so obvious is that this development has grown within our midst and we are inclined to accept it and not to stop and recognize as fully as we might that these are real complications, that they do introduce new problems — the problems of administration, organizational development, and training.

Another reason why I feel this problem deserves consideration in this society is that the whole concept of business administration and the detailed problems of personnel training and selection are in the development stage, and this group could contribute significantly. Most of us here obtained our training in engineering in a technical school, and twenty or thirty years ago, there was no thought given to the subjects of business administration, job description, personnel development and training. I, for one, felt that this was a field apart and tended to avoid it. It was believed that that was a subject for experts with special types of training. However, my thinking has changed. First of all, I think we are being forced to change. Things are not becoming less complicated; they are becoming more so. I read all the ads in your magazine, the *Iron and Steel Engineer*,

and I do not see where any of the vendors are advocating eliminating the instruments and gages. In fact it seems to me that they are encouraging the installation of more, and they are right in doing so, but as things become more and more involved, the needs become more acute.

Further evidence of the acceptance of the problem of administration as a real one that we as engineers and operators should recognize, is the fact that most of the engineering schools now introduce courses on that subject. I believe that one of them has gone so far as to give a graduate course in business administration which is available for graduate engineers. Other evidences are the increased number of executive training courses, management societies, and seminars sponsored by industry. And with them, of course, are a myriad of books that are being written. Certainly this is sufficient evidence to prove to us that there is a technical field of administration.

Now we are inclined to think that it does not apply to us; that it applies to other businesses, banks or something like that, and we do not accept the fact that it all applies to each individual department or subdepartment in our steel plants. There are problems to be worked out in each one of these units and methods to be installed, and they have to be worked out if there is to be a really successful operation. Since they have to be worked out for a really successful operation, it is perfectly obvious that someone skilled is going to do it. If that someone is someone trained in the field of business administration, then the job will fall to him, in spite of the fact that that person has little or no knowledge of the operation of the department itself.

Urwick, when he talks on this subject, is inclined to belittle much of what he himself has written, and cautions that we should "let reason and common sense prevail." We are inclined to be scared out by the jargon of these industrial administration people, and all too willingly let the problem fall into their hands. The good minds of the engineers who have such intimate knowledge of the essentials of construction and operations can, with relatively little effort, make tremendous contributions in this area, once they set their minds to it. I am fearful that if they do not, we may go through a cycle such as has occurred in many businesses. An aggressive individual some fifty or sixty years ago, because of his own energy and skill, built up a business. Gradually, as the complications of doing business increased, he hired lawyers to help him solve the problems, and with still further increases in the complications and restrictions, the need for the lawyers became greater and greater, until eventually the lawyers took over the running of the business. The point I want to bring home is that our processes are becoming more and more complicated and the job of coordinating all of these specific technical processes and skills becomes more and more important. The job of coordination and organization must be done, and if we lack these skills of coordination and administration, then the job is going to be done by experts in the field of pure administration.

Now let us leave the discussion of the general problems of administration and turn our attention to a particular phase of that problem, namely, training. Formerly the accepted way to make a plant pipefitter was to take some man out of the labor gang and put him with a pipefitter. If the pipefitter was a good teacher and wanted to teach, and the helper was a reasonably qualified pupil who tried to learn, the helper eventually became a pipefitter. If he did not learn or the pipefitter did not get on with him, the apprentice was transferred or fired. That system worked well and we got along with it for many years. The same method was used to train people for operating jobs, and where I was brought up, that was the way a blast furnace superintendent was developed. A likely young fellow, just out of college with the proper technical training, was hired and put in the labor gang. After various experiences in the capacities of helper for a millwright, pipefitter, scale car operator, cast house man, he was made a stove tender and later promoted to blower and so on up. This was typical in blast furnaces and equivalent training was typical in the industry as a whole.

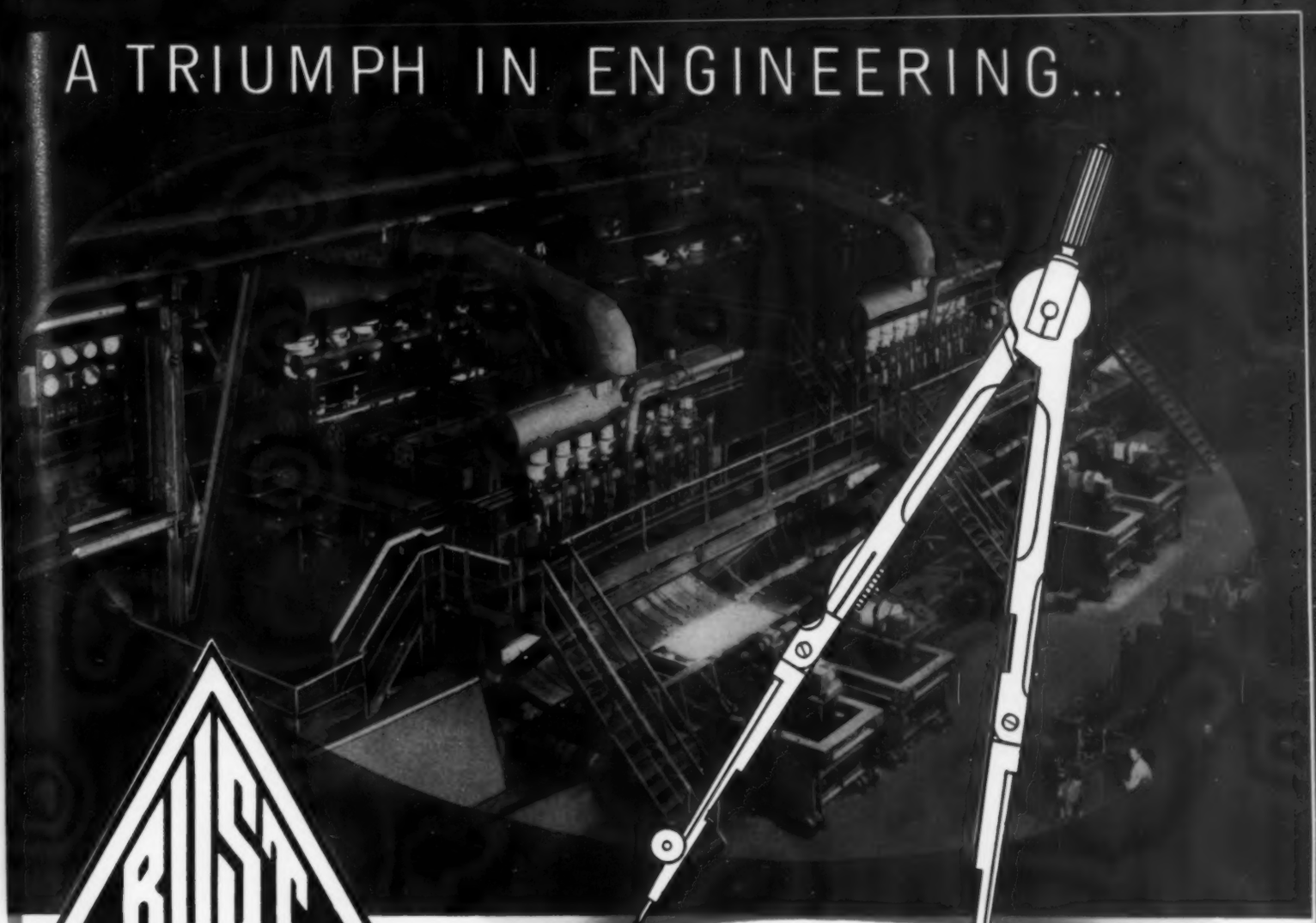
The system had many merits, the principal one being that it did make competent operators. One of the main advantages of that system, and one which I think should be incorporated in any system of training, is the fact that these men, who were being developed, were expected to do many of the manual jobs along the line. Now, understand that I think it is ruinous to put future administrators on jobs that are extremely severe physically and make them sweat it out just to see if they can take it. However, I think it is equally wrong not to expose them to these jobs to some degree. Doing any of these for a short period of time gives them the opportunity to learn 95 per cent of what they would learn if they were on the job for a year, and once having actually done the work, it gives them a confidence which they would never gain in any other manner. Having done the work, there is the further advantage that all the people whom later they have to supervise will know that they have done the work and have an appreciation of the efforts and skills required of the workmen and so have respect for them and their jobs.

As our processes increased in complexity and various other changes took place, this system of training proved inadequate. There was a need to supplement it in order to meet the new situation. Because the problem was nebulous, there was no clearly defined solution. The result of this was a series of attempts sponsored by people whose motives or interests varied widely. They ranged all the way from operating people making abortive attempts to be educators, after being exposed to a couple of lectures, to academic people promoting definite programs with little or no knowledge of the plant problem. Together with these were the smart guys who were after the "fast buck," who flooded us with literature and pressures, some of it so bad that I have sat through some sessions that actually approached being vaudeville acts.

We at Inland also recognized that the problem was changing; there was a need to supplement our previous programs and we have done our share of groping. We have undertaken various things — some terrible — some good. We have learned from these attempts and we now feel that we are on somewhat firmer ground.

Under the enthusiastic support and direction of F. M. Rich, our general superintendent, and T. F. Plimpton, assistant general superintendent in charge of industrial relations, we have set up a steering committee

A TRIUMPH IN ENGINEERING...



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made up of department superintendents under the direction of Dr. Maurice Graney of Purdue University who is on leave and working with us. We now have what seems to be a reasonably satisfactory program. Some of it has been in operation for several years, and some of it is still in the development stage.

On "on-the-job" training we have spent a little time refining job sequences. I have always believed that it is our responsibility as supervisors to try to place every employee so that he can teach the man who occupies the job he just left and can learn the job to which he will be promoted. This is just common sense and has always been done to a degree. As far as we can, throughout the plant, we have studied all the jobs and prepared these logical job sequences. This, I think, is the biggest contribution we can make toward good "on-the-job" training.

The formal training programs are divided into three categories: training for men in the work force, for pre-supervisory personnel, and for supervisory and professional personnel. For people in the work force, in addition to the "on-the-job" training resulting from the job sequences already mentioned and the usual apprentice programs for the various trades, we have cooperated with Purdue University in a two year technical course at college level which has worked out very successfully. We are now working with the public schools for courses at high school level to fill specific needs.

We have set up programs for screening our work force for potential supervisory people and then have programs designed for these individuals selected in order to train them to fill specific supervisory jobs that are going to be available. All other candidates are encouraged to take courses given in public schools to correct their obvious deficiencies so that they will be better prepared if openings should develop.

Two training programs for college graduates are in operation, one being a general orientation course of men who may go to work anywhere in the company, and the second a more specific program for men who remain at the plant.

For several years we have cooperated with Harvard and the University of Chicago on special educational programs for supervisors and professional employees. These, together with participation in trade and professional organizations, coupled with various programs we have at the plant, have proven stimulating and broadening to our supervisory personnel.

If any of these are of interest to you, we would be very glad to have you come and visit us, or, if a year from now you would like a more detailed report on exactly how the newer programs have developed, I am sure that Dr. Graney would be very glad to tell you about it.

When ore boats were unloaded by men with shovels and when blooming mills were run by steam engines with 100 pounds of pressure, there was a need to concentrate on engineering problems. There was a terrific amount of work to do in that field and the good minds of the engineers saw the problems and went to work on them with the result that terriffic progress has been made. However, these developments have brought on new problems in administration, organization, and training. I would urge that, while you continue to give these engineering problems the attention they deserve, you should reserve some part of your energies and talents to this other area where you could make significant contributions.

THE PROSPECTS FOR AMERICAN INDUSTRY*

▲ THE steel industry's role in our national economy is to give the consumers of steel more and better products at the lowest workable costs, to provide productive full employment to its workers at living standards conforming to those of a progressive social economy, and to play its full part in strengthening the national defense and meeting all national emergencies.

In order to fulfill this role, it is necessary that the steel industry provide adequate and improved tools by replacing those that are obsolete, by adding modernized facilities which meet the highest standards of technical industry, and by pursuing a vigorous program of improved technology.

Because the steel industry has been in a sub-parity position with respect to the rest of the industrial economy in prices and consequently in profits, it has been unable to fully discharge its duties. It is, therefore, essential for the industry to achieve economic equilibrium with the rest of the economy. To do this we must correct an obsolete price structure and thereby restore investment status to the steel industry so that it can compete with other industries for risk capital.

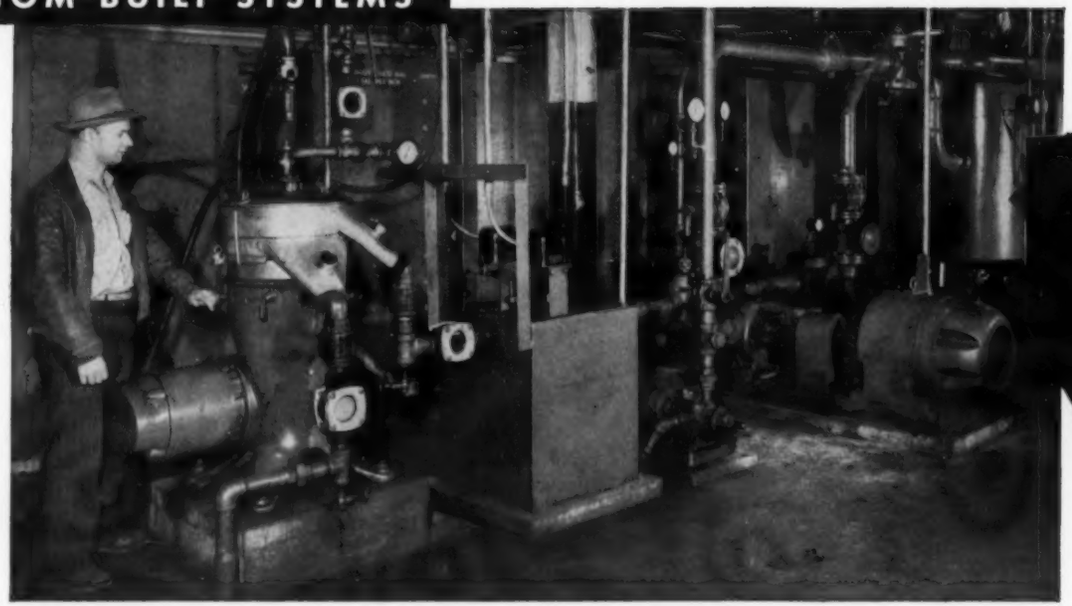
We have been characterized in recent years as a "feast and famine" industry. There is an exaggeration to this because so far as profits in the prosperity years of the past decade are concerned, our industry has not shared in the feast that was experienced by its economic companions in durable goods production. I see no inherent reason why the industry should remain subject to the burdens of inadequate profits. Rather do I see for it, once the basic price disparity is corrected, an epoch of prolonged high activity and adequate returns for the old and attractive new investment in conformity with the requirements of a balanced and progressive business and social economy.

What then are the prospects for American industry? They are what we, the people, choose to make them. We must maintain a "climate" of free and responsible competitive enterprise, without government restrictions and with maximum freedom and incentive for the individual. In such a climate, American industrial genius will thrive and expand and will discharge its obligations to the Nation.

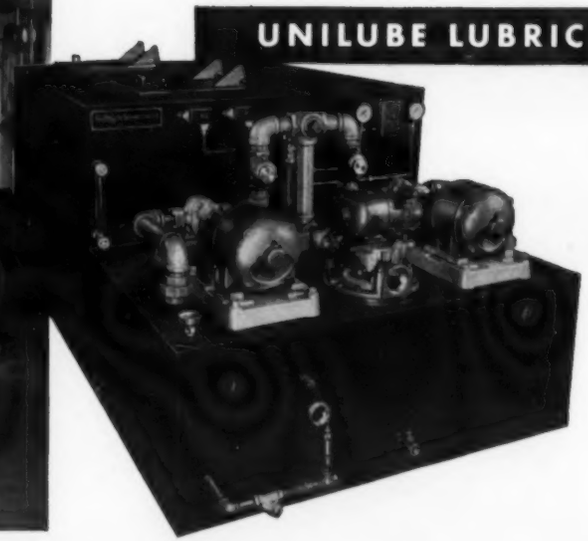
*Abstracted from paper of same title presented by Admiral Ben Moreell, president, Jones & Laughlin Steel Corp. at Pittsburgh Regional Meeting of AISI, October 11, 1950.

A LUBRICATION SYSTEM FOR EVERY SIZE MILL

CUSTOM-BUILT SYSTEMS



UNILUBE LUBRICATION



For large mills, De Laval designs custom-built Lubrication Systems that are completely engineered to a specific mill. Every detail is worked out carefully: proper application of the lubricant, correct metering for best lubrication, efficient temperature control, even the correct size of pipe. Care is taken to see that these Systems not only lubricate, but are of sufficient capacity to cool as well.

For smaller mills, De Laval offers a line of completely assembled unit pressure Lubrication Systems in sizes from 1 to 40 gpm. capacity. These complete, compact systems, furnishing lubricant in a streamline pressure supply to bearings and gear meshing points, incorporate in a single unit automatic full pressure filtration and automatic temperature and pressure control of lubricant supply.

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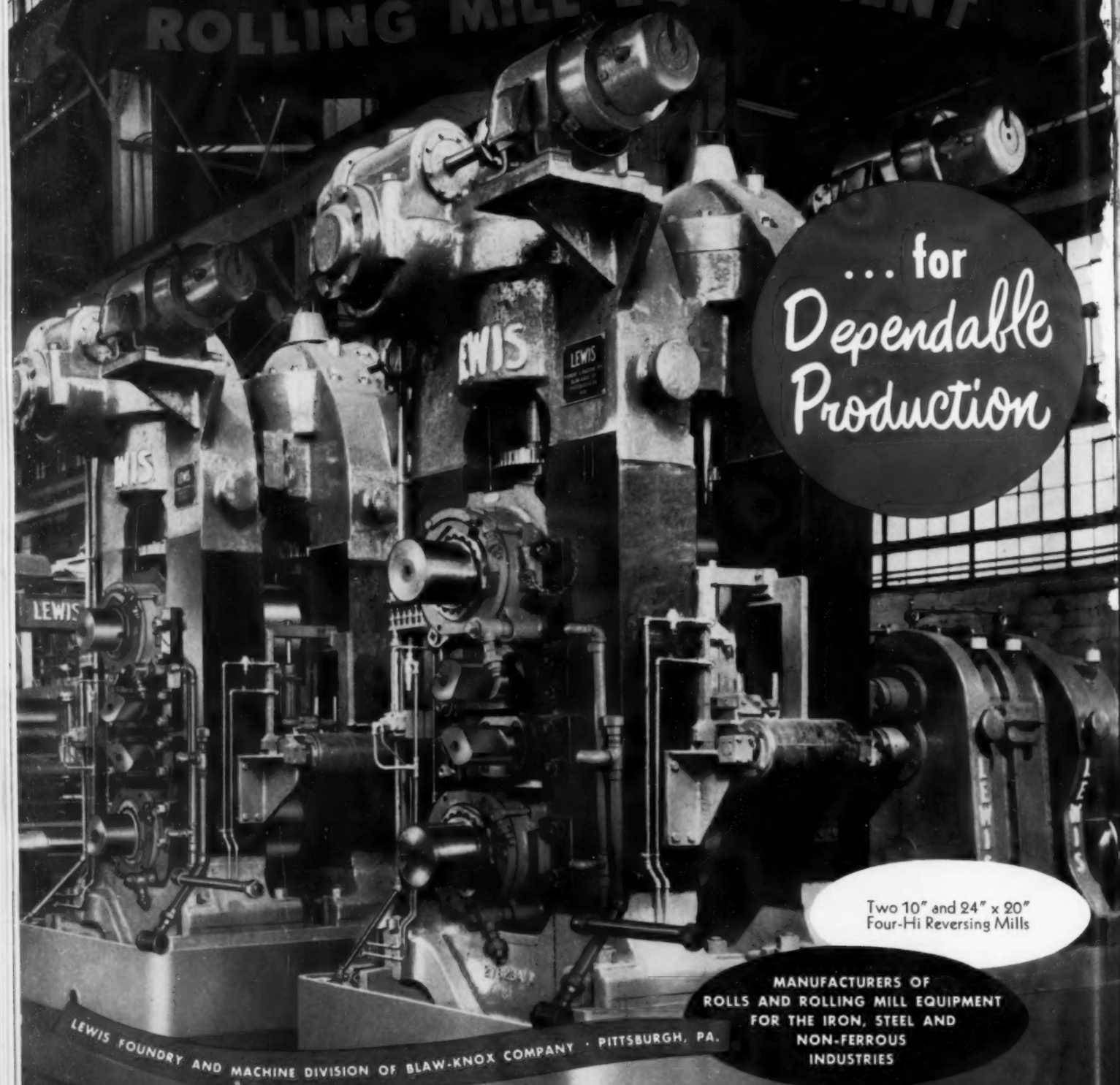

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ENLARGING STEAM PLANT AT IRVIN WORKS

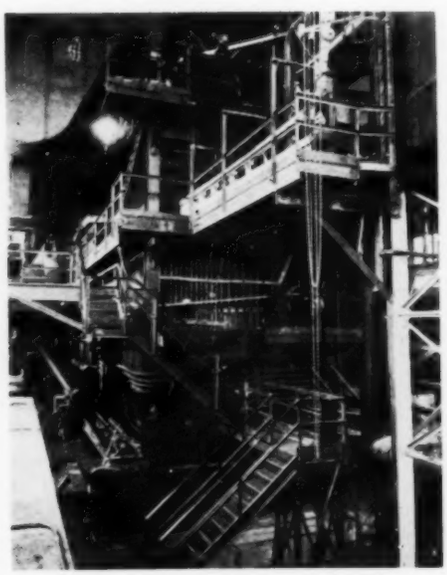
By ROBERT LACY
Project Engineer
Dravo Corp.
Pittsburgh, Pa.

▲ When it was erected in 1937, the United States Steel Company's Irvin Works, just outside of Pittsburgh, was the largest and most modern steel finishing plant in the world. Its original rated capacity was 600,000 tons annually. The great demand for products of the Irvin Works over the years, however, has necessitated plant expansion programs which have kept this facility as one of the finest in the country. Today, under normal operating conditions, the Irvin Works has a production output of strip steel that totals well over 2,000,000 tons a year.

Increasing the steel output over three times required more and more steam for vital heating and processing. Therefore, the boiler plant at Irvin Works has been enlarged three times by the original contractor, Dravo Corp., to provide necessary steam for the huge mill. This article describes the features of these boiler plant enlargement projects.

The mill started to roll steel in the Spring of 1938 when one of the five stand tandem cold reduction mills was placed in operation. A short time later the tin plate operations started and in the Fall of the same year, the hot strip mill was rolling steel. It was not until October 9, 1942 that the first electrolytic tinning operations commenced.

Figure 1 — In latest addition to the boiler house can be seen the arrangement of the boiler tubes through which the water circulates to generate steam for the mill. This boiler had steam up six months after its construction was started.



STEAM GENERATING EQUIPMENT

The original installation consisted of two 860-hp, 250-lb ASME design, Babcock & Wilcox Sterling type fuel-fired boilers operating at a pressure of 200 psi at 530 F total temperature. A feature of these boilers was their versatility in being able to burn coke oven gas either alone or in conjunction with coal or coke breeze. These boilers are equipped with forced-draft chain grate stokers. The steam generating capacity of each boiler was 60,000 lb per hr.

Two inclined waste-heat boilers each having 6700 sq ft of heating surface were built by Combustion Engineering Corp. These waste heat boilers have a total capacity of 25,000 lb per hr at the same pressure and temperature as the fuel-fired boilers. They are steel-encased fire-tube design, of 670 hp each, designed for 178,000 lb of combustion gases per hour at an inlet temperature of 1000 F and exhaust at 550 F.

It is interesting to note that these waste-heat boilers do not carry a fire under them for steam is generated by passing through the boilers hot gases which would otherwise be dissipated into the atmosphere. The hot gases so utilized come from gas-fired furnaces located in an adjacent mill building, where steel slabs are heated preparatory to rolling into thin sheets. The flue through which the hot gases pass to the boilers is 16 ft, 6 in. in diam and 110 ft long, lined with fire brick. Fans on the waste-heat boilers draw the hot gases through the boilers, and this so-called waste-heat produces steam required for heating in the mill.

In 1941 it was necessary to install an additional Babcock & Wilcox Sterling type fuel-burning boiler rated at 850 hp with a chain grate stoker and a steam generating capacity of 80,000 lb per hr.

The post war demand for steel, however, made it apparent by 1947 that the capacity of the boiler house would again have to be increased, and certain changes were made in the boilers, increasing the capacity of two of them to 80,000 lb each per hour.

Then, in 1949, the capacity of the

Figure 2 — The operator is observing some of the instruments on an automatic boiler control panel. Provision is made for switching from automatic to manual control, when desirable.

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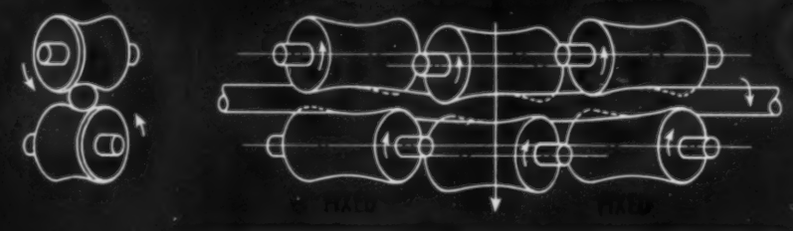

The Mackintosh-Hemphill method of straightening is accomplished by an offset cross-roll pass between two fixed cross-roll passes (patented). No guides are required because the rolls are driven on both sides of the stock which is supported by the bottom rolls. With this balanced arrangement there is no decreasing efficiency from uneven wearing of the rolls. The straightening takes place from section to section and not from point to point.

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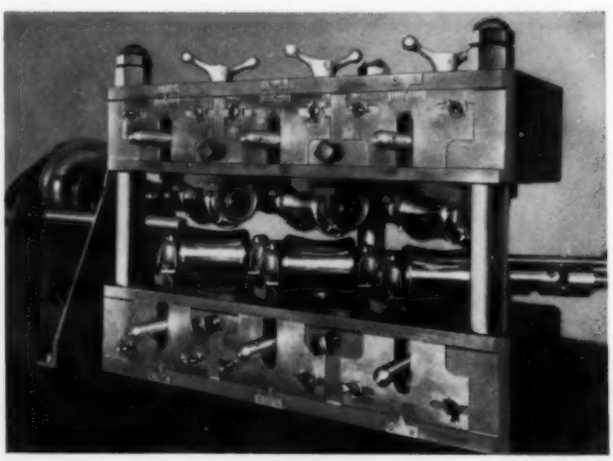
Mackintosh-Hemphill Rotary Straighteners employ a patented roll arrangement with an offset cross-roll pass between two fixed cross-roll passes.

This feature eliminates supporting guides for the material and increases the productive life of the rolls.

Send for bulletin 2171-S which describes, in detail, the Mack-Hemp Rotary Straightener.



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steam plant was further expanded by extending the boiler house building and installing a new Babcock & Wilcox Sterling type boiler. This forced draft chain grate stokered boiler has a rated capacity of 100,000 lb of steam per hr when coal fired.

POWER HOUSE AUXILIARIES

Cars are delivered to the boiler plant on a siding where they are unloaded into a hopper underneath the tracks. From the hopper, the fuel handling is virtually automatic. Bucket elevators carry the fuel to the shuttle conveyor belt which in turn supplies the overhead suspended type bunker from which the fuel is fed by gravity to the boilers. As a part of the improvements made in 1949, the coal bunker and conveyor were extended and the coal handling system was improved by the addition of a new track hopper into which the fuel from a 50-ton car can be dumped in one operation. A building over the track hopper was also constructed to house a motor-driven car shakeout.

The water treating equipment originally installed consists of a hot process softener with two filters, proportioners and chemical mixing tanks with pumps. In 1947, the Dravo Corp. installed another hot process softener and additional filters with a capacity of 32,000 gphr.

Two Cochrane deaerating heaters, each of 265,000 lb per hr capacity, not only heat the water to the temperature of the heating steam, but also thoroughly purify it of dissolved gases, such as oxygen and carbon dioxide, which, under boiler operating conditions, would cause corrosion inside the boiler drums and tubes.

Original boiler feed pump equipment consisted of two 400 gpm pumps, one driven by a steam turbine and the other by a 100-hp motor. Also in 1947, a new 800-gpm DeLaval turbine driven boiler feed pump was installed. An identical pump, driven by a 200-hp motor, and an additional turbine-driven pump, were installed in 1949. The present installation consists of three 800-gpm boiler feed pumps, two of which are turbine driven and one motor driven.

All piping was installed by the Dravo Corp. and one of the outstanding features of the boiler feed, steam and water treating systems is the method of sectionalizing the pipe so that parts may be cleaned or repaired without any interruption of service. This sectionalizing consists of installing a by-passing arrangement so that one section of piping may be shut off while the other section still feeds the boilers.

The boilers are equipped with automatic Bailey Meter Co. controls and regulators. A complete system of gages and instruments is mounted on suitable panels for indicating and recording conditions at all times.

A new self-supporting, brick lined stack, 225 ft high, with an inside diam of 10 ft 6 in. was built to take care of the most recent boiler additions to the power plant.

The Allen-Sherman-Hoff ash handling system removes the ash from the pits under the fuel-fired furnaces and sluices it to a storage pit located in the basement. From this pit, a specially-designed ash pump delivers the ash, mixed with water, to an outside storage hopper, located above the railroad siding. Water is decanted from the ash storage hopper and then, when a gate is opened, the ashes drop into cars which are placed under the hopper.

The main building extensions were designed and built by the American Bridge Co., and covered with corrugated stainless steel sheets. This type of building material has the unusual advantage of requiring no painting.

HOW THE STEAM IS USED

The plant area to be heated is of considerable acreage and under the usual steel mill operating conditions that require frequent opening and closing of large doors for trucks and for ventilation. Because of this, the heating load is exceptionally high as evidenced by the fact that about 180 Carrier steam heater units are in use. The balance of the steam generated is used for process work, such as pickling, cleaning of sheet material, etc.

Figure 3 — Ashes from the storage pits under the boilers are washed into the concrete chamber at left, from which they are sluiced into an ash sump. At right is shown a motor which drives an ash pump, removing the ash from the pit and discharging it in a stream of water to the outside storage hopper. The large hopper in the center collects and discharges fine stoker siftings into the same removal system.

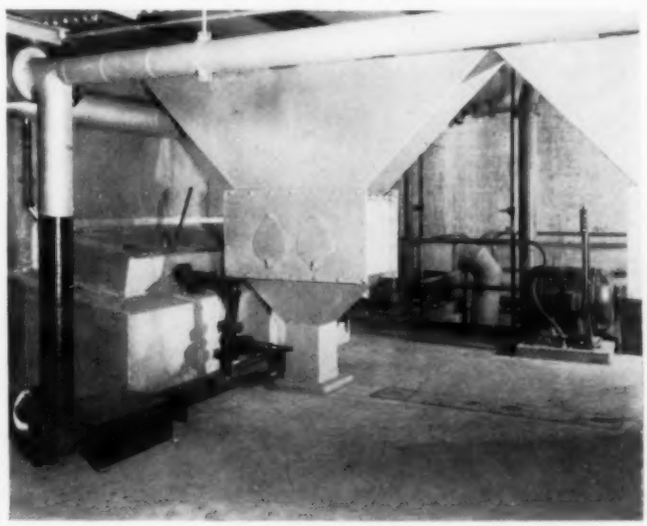
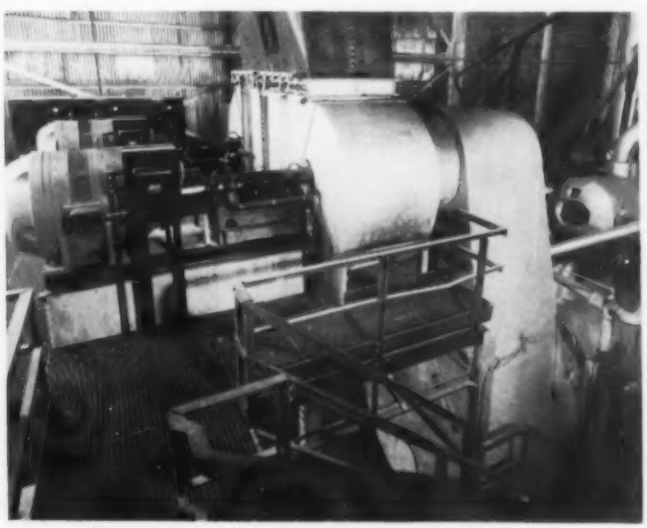


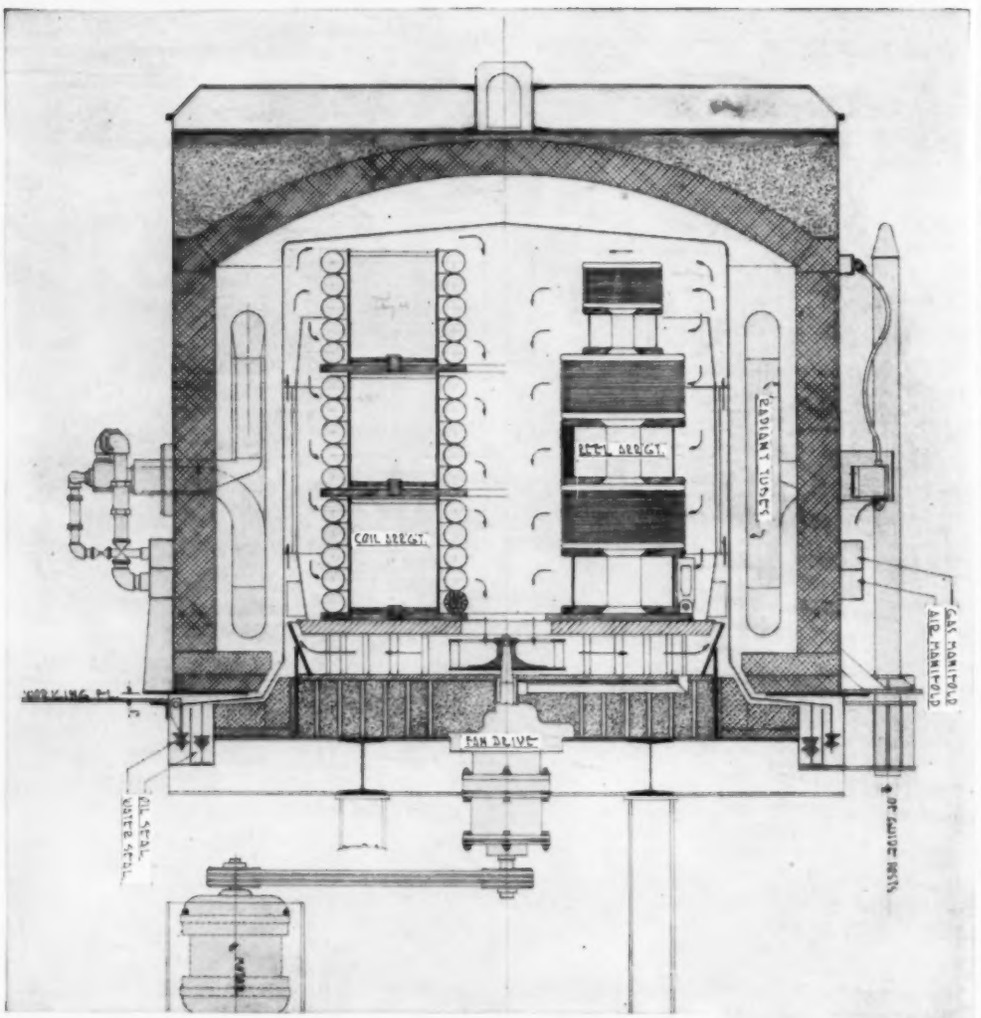
Figure 4 — Large motor-driven fans draw hot gases through the waste-heat boilers and discharge them into the steel stub stack located above the fans. At lower right is shown a portion of the waste-heat boilers.

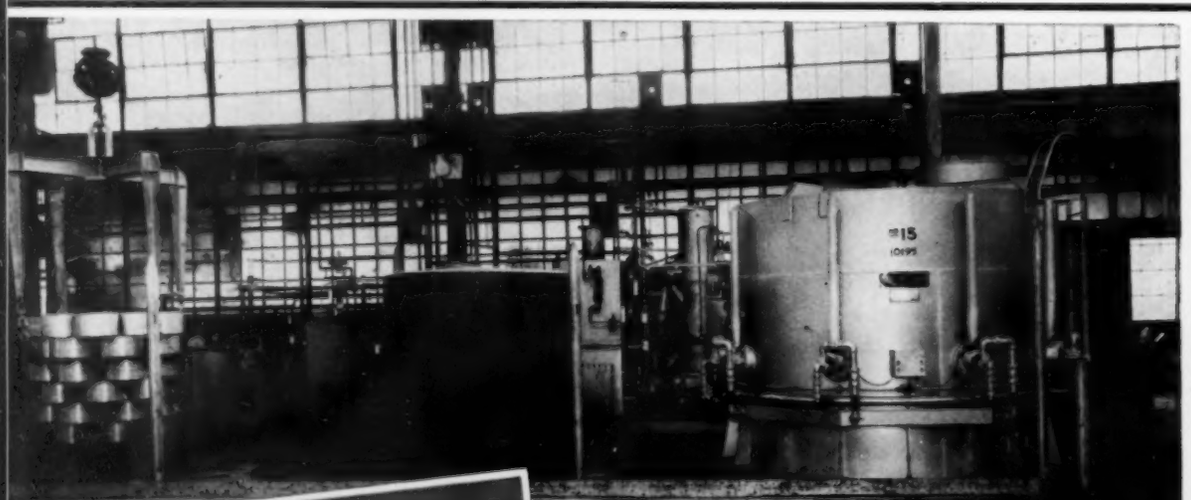


HIGH CONVECTION ANNEALING

For Ferrous and Non-Ferrous Wire

THE Lee Wilson radiant convector annealing furnace is now ready for applications to WIRE ANNEALING. Tremendous recirculated gas velocities produced by 15 HP fan drives give finishes and yields far beyond previous standards set for wire annealing.





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BELL TYPE FURNACES ± RADIANT TUBE HEATING ± ANNEALING PROCESSES

A NEW METHOD OF MACHINING

By JOHN S. ROLLER
General Manager
The Method X Co.
Philadelphia, Pa.

. . . . this is the most revolutionary metalworking machine to appear since the introduction of the lathe . . . .

▲ A completely new method of metal removal which employs the direct utilization of electrical energy for the machining of any electrically conductive material has been developed and made available to the metal working industry. The method X machine removes metal in a directed manner by means of an electric spark discharge which does not otherwise affect the work material's physical or chemical characteristics. The process is made available through the Method X Corp. of Philadelphia, an affiliate of the Firth Sterling Steel & Carbide Corp.

Figure 1 — The method X machine performs all machining operations ordinarily accomplished in metalworking such as boring, drilling, tapping, internal and external shaping and engraving. An electrode, negative of the shape to be produced, is fed directly into the material. The loosened particles are carried away from the work area by a dielectric fluid in which the machining operation takes place. The machine operates from a remote power supply fed from a 220-v, 60-cycle, single-phase line. Peak power demand does not exceed 7 kw.

The machining action depends on a mechanical, not thermal, effect of electricity which sets up internal mechanical stresses by the use of extremely high current densities and thereby cause the metal particles to detach themselves from the work material without resort to melting. The exposed surfaces thus remain unchanged and surface finishes of 26 micro inches rms can be obtained. Lapping of less than 0.001 in. will produce any desired finish down to 0.15 micro inches on sintered carbide. Center to center spacing of holes through the same workpiece can be controlled to approximately 0.0005 in. Blind hole filet radii can be made as small as 0.002 in.

The fabrication difficulties of sintered carbides, superalloys, S-816, vitalium and hardened steels has somewhat restricted their uses. Now, the method X process not only can be used to machine the conventional machining shapes but extend the uses of these hard-to-machine metals by forming complicated geometric shapes economically and rapidly that are not even practical with other machining methods.

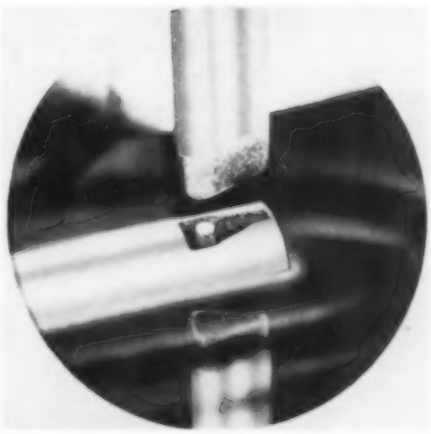


Figure 2 — Metal removal is a mechanical, not thermal, effect of electricity on the material being shaped. Particles detach themselves without melting, leaving the exposed surfaces unchanged physically or chemically.

An example of this is the materials used for gas turbine blading. Blade root mounting serrations are being laboriously ground for the intricate shapes required and to extremely close tolerances. Blade sections are shaped by show contour milling, precision casting or hammer forging. All processes are relatively slow and comparatively expensive.

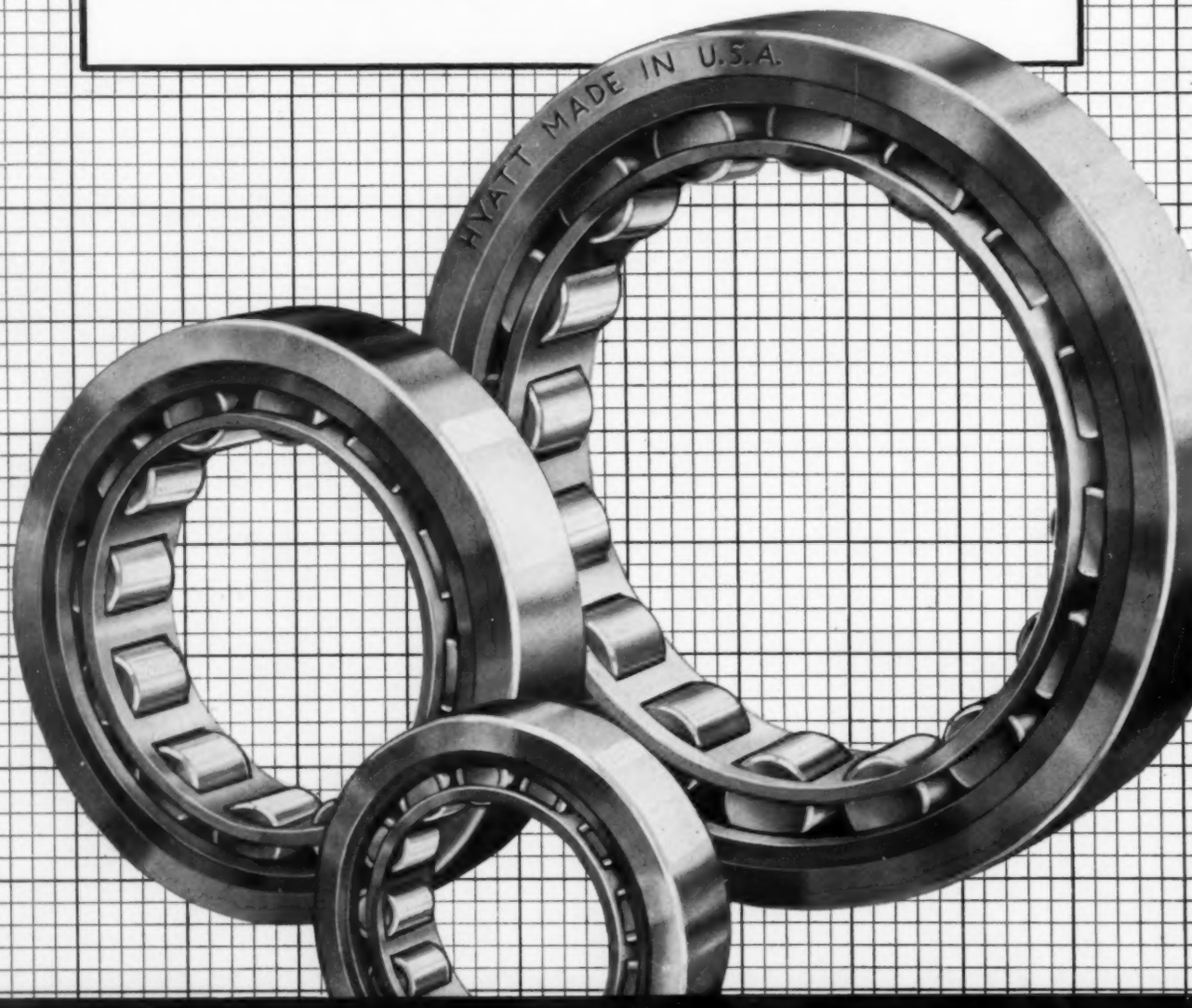
Die sections of sintered carbides are generally fastened by means of threaded steel sections brazed into the carbide and secured to the backing blocks by screws. Another means of fastening

There's a correctly designed HYATT *for each application*

When Hyatt Roller Bearings are built into tables, cranes, cars, mill motors, and other equipment, you can be sure that the bearings are ideally suited for the job.

With a correctly designed Hyatt for each application, the equipment designers, working in close harmony with our experienced bearing engineers, make this assurance doubly sure.

Thus for easing shock loads, extending equipment life, and helping to reduce operating costs, Hyatts are the preferred Steel Mill bearings for new equipment or changeovers. Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.



HYATT ROLLER BEARINGS

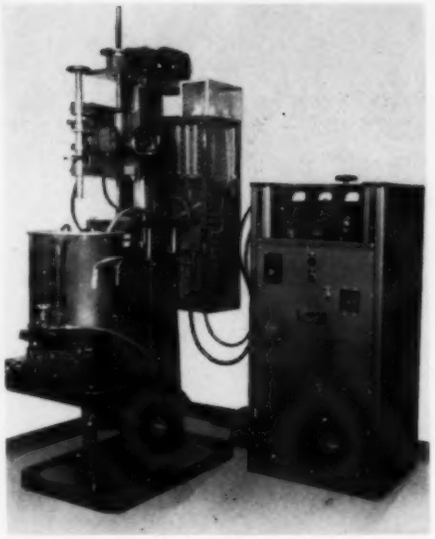


Figure 3 — The equipment is relatively compact.

die sections is to shape, drill and tap wedges to fix the carbide die sections to backing blocks. Both methods are slow and costly and not entirely satisfactory since either type leaves the mountings subject to loosening due to shocks encountered in service. Brazes may fail or wedges may work loose. In either case, failure of expensively fabricated die sections may result.

Metallurgical research experiments and tests require holes or slices cut in superalloys, high temperature carbides and ultra hardened steels without destroying or changing the exposed surfaces either physically or chemically.

The application of method X to all these problems offers an answer. Gas turbine blade contours and root serrations can be readily shaped with Method X. Hardness has no effect on machinery speed. Sintered carbide die sections can be bored and tapped so that direct fastening to the backing blocks with machine screws can be accomplished. Complicated geometric shapes can be shaped directly into the hardest of metals.

The problem of warpage encountered in heat treating steel dies composed of symetrical hole shapes such as for cookie dies for electrical stator laminations can be eliminated completely by first heat treating the solid steel section then machining the desired shapes by the method. Sintered carbides undergo a shrinkage of 15 to 20 per cent which is not uniform in all directions and it is therefore, often impractical to form several hole shapes in the half-sintered carbide and then expect hole centers within close measurements. By utilizing the method, simple geometric shapes can be produced as hardened pieces and then accurate machining of the desired holes can be done rapidly and accurately. Much of the laborious grinding and lapping time usually associated with sectional dies can be eliminated completely now. Threaded fastening holes and work sections, no matter how complicated, can be machined in the hardest and toughest of carbides.

The equivalent of all machining operations ordinarly accomplished in metalworking such as boring, drilling, tapping, internal and external shaping and engraving by using the electrode as a cutting tool can be done expediently with method X. In addition, the method can perform some machining operations not at all practical even with ordinary machinable materials on conventional machines. For example, see the work piece in Figure 2.

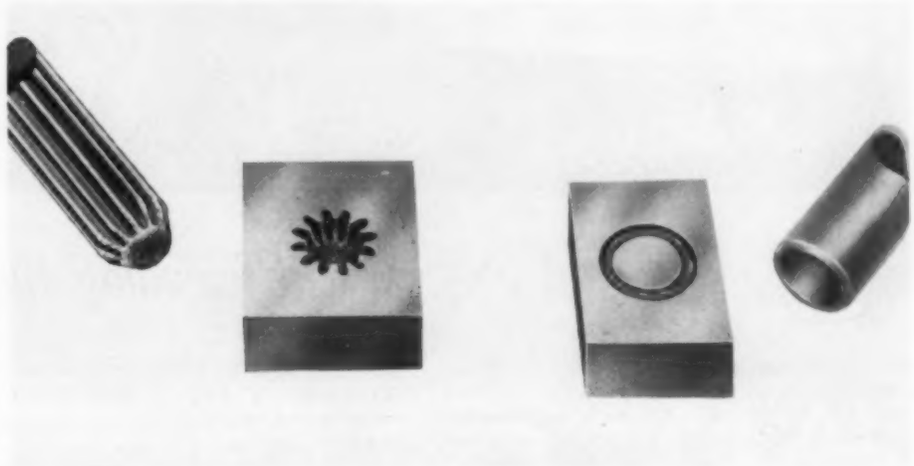


Figure 4 — Gear and ring compacting die sections produced directly in solid, sintered carbide. The punch for the gear section can also be machined in sintered carbide by using a shaped electrode as a cutting tool and shaping the splines in the conventional manner on the method-X machine. (The gear shaped electrode shown is made of brass.)

It is a blind triangular shape, open at the apex and has an integral pin located in the center of the triangle. The shape is formed by the use of an electrode made to the shape desired and fed directly into the work piece by the method X machine. A second finishing operation is performed with the use of the same electrode by cutting off the eroded end of the electrode and making necessary electrical adjustments and reentering the electrode in the rough shaped hole.

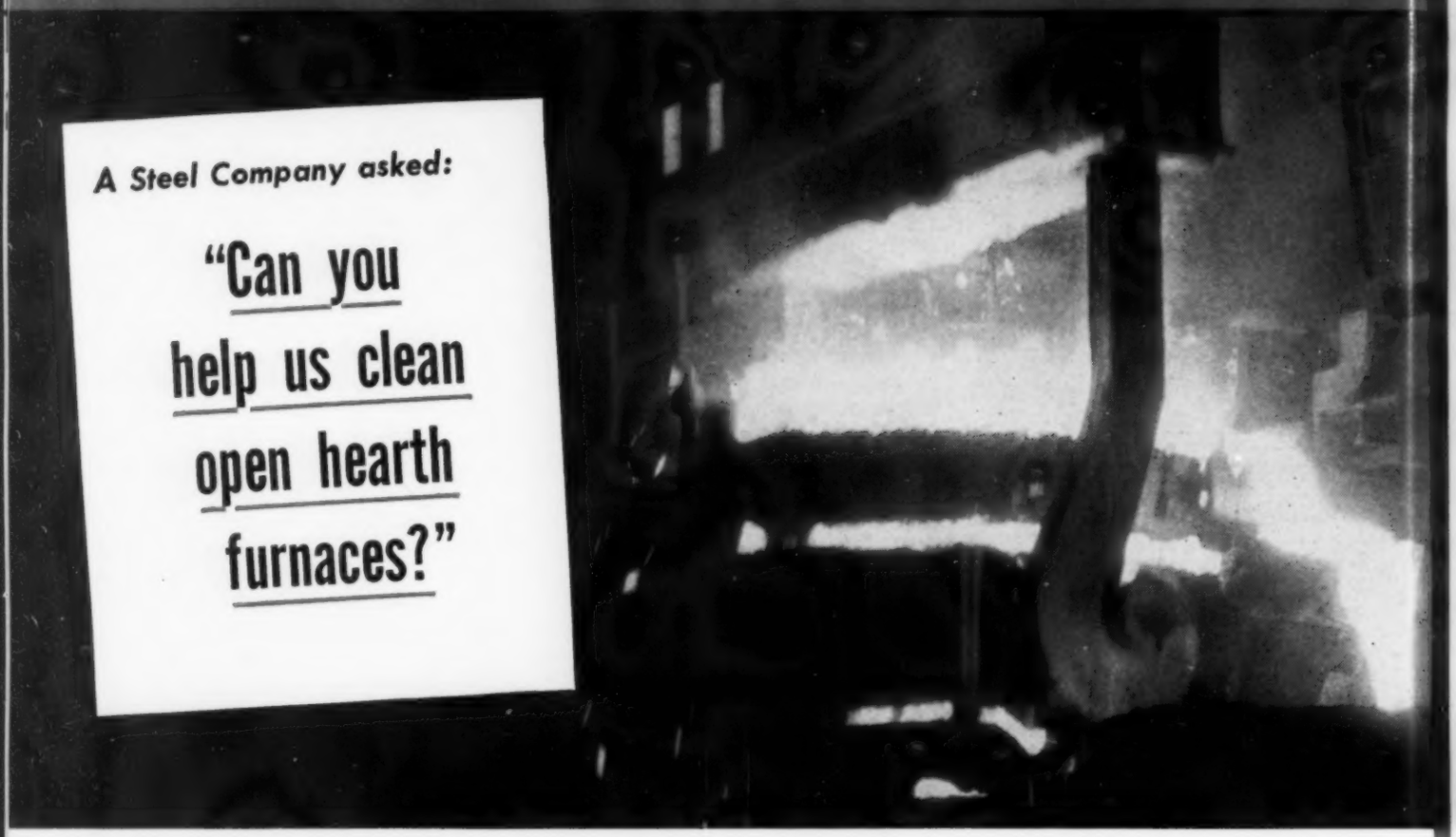
The machine's design is similar to a drill press with a pedestal type base, an electrode feed and control mechanism, and a remote unit power supply. The machine has a work table provided for longitudinal, lateral and vertical traverse and full rotation for work alignment. Electrode feed is automatically controlled by rotating regulator and associated circuits so that optimum cutting speeds for a given cutting condition is maintained. The power supply is fed from 220 volt, 60 cycle, single-phase lines. The peak demand under the most severe cutting conditions does not exceed 7 kw.

A dielectric fluid such as fuel oil, kerosene or a compound especially developed for this purpose, dielectro X, is used to enclose the cutting operation. The purpose of the work submersion in the fluid is to build up electrical resistance so that the energy storage devices in the machine may be fully charged prior to discharge, and secondly, to flush the loosened particles from the work area. No fluid is lost except through evaporation or carry off on the fabricated parts.

Electrodes are made of a highly conductive, easily machined material, such as brass although other conducting materials may be used. They are usually machined to a negative of the shape to be produced when the machining operation can be performed with the head moving in a vertical direction. When the machine is required to revolve, or the work table traverse, for an internal irregular contour such as illustrated in Figure 2, an electrode of brass wire bent to the necessary working angle is all that is required since the tool does not make physical contact with the work.

DOWELL SERVICE

CHEMISTRY APPLIED TO MAINTENANCE CLEANING PROBLEMS



Dowell Service *cut checkerwork cleaning time by one-half!*

Downtime means lost production to your plant. That's why Dowell Service has become so important to cleaning many types of industrial equipment . . . *with a minimum of dismantling and downtime!*

For example, the oil fired checkers of an open hearth furnace were badly clogged with flue dust deposits. Dowell Service was applied to all four checker chambers. Work was started during the last heat before the furnace was taken down for relining. In just 10 hours, the checker chambers were an estimated 85% clean. After Dowell Service, only one-half the usual downtime was necessary to complete the cleaning using regular plant procedures.

There are many other types of equipment in a steel plant which have been cleaned effectively by fast Dowell Service . . . such as gas washers, boilers, dust catchers, water lines, gas mains. Trained Dowell engineers use Dowell-designed pump trucks and control equipment to introduce liquid solvents specially prepared for each job. These solvents are designed to dissolve and to disintegrate deposits and are applied according to the technique demanded by the job: for example, by filling, spraying, jetting, cascading or vaporizing.

Call upon the experience of Dowell Service . . . to help you increase production. Phone the nearest Dowell office for FREE consultation on your industrial cleaning problem.

Other recent Dowell jobs:

Before cleaning, it was necessary to use three 100 horse-power pumps to force water through clogged feedlines to a boiler house. Following Dowell Service, only one pump was required.

•

A boiler was making only 12,000 lbs. of steam per ton of coal. After Dowell Service, production increased to 18,000 lbs. of steam per ton of coal . . . a 50% increase in efficiency.

•

Two Cottrell Precipitators were Dowell-cleaned. Result: an estimated 20 tons of scale were removed from each unit.

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Richmond 19	Wichita 2	Upper Montclair, N. J.	Borger, Texas
Jacksonville 2	Oklahoma City 2	Anniston, Alabama	Midland, Texas
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★ *Maintenance cleaning service for industrial heat exchange equipment.*
★ *Chemical services for oil, gas and water wells.*
★ *Magnesium anodes for corrosion control.*

DOWELL

A Service Subsidiary of
THE DOW CHEMICAL COMPANY

Date-line Diary...

September 1

▲ Westinghouse Electric Corp. reported sales for the first half of 1951 of $590,562,000 compared with $461,731,000 in the first half of 1950. Net income for the first half of 1951 was $31,564,000 or $1.98 a share compared with $27,207,000 in 1950.

September 3

▲ American Iron and Steel Institute reports that the Venezuelan government is considering construction of a small steel mill which will use the newly developed ores in that country. Natural gas may be used to reduce the ore.

▲ The steel industry will receive allocations of only half of the amount of structural steel it will want for the next three months to expand its facilities according to the DPA.

September 4

▲ Based on reports of companies having 93 per cent capacity of the industry, the operating rate beginning September 4 is scheduled at 98.3 per cent of capacity. This is equivalent to 1,965,000 tons compared with 1,995,000 tons one week ago.

September 5

▲ Labor Department reports that hiring of workers during July dropped to the lowest rate in over ten years with one exception.

▲ A newly formed Tenn-Tex Alloy and Chemical Corp. will provide Houston, Texas area with new source of ferromanganese and similar alloys upon completion of new plant which they are building.

▲ DPA approved a loan to the Harvey Machine Co., Torrance, Calif. which will enable them to enter the primary aluminum field. Plant is expected to be located at Kalispell, Mont.

▲ Bolivia and the RFC contracted a tin purchase agreement which set a purchase price of $1.12 a lb.

September 6

▲ Bethlehem Steel Co. set a new pig iron production record when furnace H at Sparrows Point produced 55,835 tons of iron in one month.

▲ Carpenter Steel Co. purchased the Webb Wire Works of New Brunswick, N. J. in exchange for shares of Carpenter stock.

▲ Inland Steel Co. stockholders approved today plan for offering employees options to buy company stock on payroll savings.

September 7

▲ American Railway Car Institute reports August deliveries of freight cars totaled 7183, orders totaled 1828 leaving a backlog on August 31 of 139,014.

▲ Mr. Wilson predicted that the steel industry would be able to expand its capacity to 118,000,000 tons by 1953.

▲ NPA stated that it doubts that the steel industry can increase its output to 118,000,000 tons by 1953.

▲ National Tube set new production records with 308,734 ingot tons at Lorain, Ohio.

September 8

▲ Sheffield Steel put into operation a 20-ft electric furnace with a rated capacity of 75 tons at Houston.

▲ Armco Steel Corp. purchased all outstanding stock of Ohio Marble Co. and Piqua Stone Products, Inc., which operate limestone quarries at Piqua, Ohio.

▲ OPS granted auto manufacturers price increases averaging from 5 to 6 per cent.

▲ Department of Commerce reports personal income in July rose to an annual rate of $251,600,000,000.

▲ NPA states that one-third of proposed construction for steel expansion will be completed by October 1, 1951, when more than $618,000,000 worth of construction will be put in place.

September 10

▲ Chrysler Corp. and Packard Motor Car Co. are loaning Pittsburgh Steel Co. $10,000,000 for which Pittsburgh Steel will send the auto manufacturers 1,000,000 tons of steel in the next five years. Money will be used for new cold rolled sheet mill at Allenport, Pa.

▲ According to AISI, operating rate for the steel industry is scheduled at 100.0 per cent of capacity for the week beginning September 10. This is equivalent to 1,999,000 tons of steel compared with 1,695,000 tons one week ago.

September 11

▲ The Aluminum Association reports that output of the primary aluminum industry in July was up 8 per cent primarily due to additional capacity. Total production was 145,395,271 lb and shipments of sheet and plate totaled 93,777,078 lb in July.

▲ Commerce Department reported that dividend payments by United States corporations in the first seven months of 1951 rose to $4,141,000,000 or 13 per cent over the same 1950 period.

September 12

▲ Defense Mobilizer Wilson called on the steel industry to expand production facilities faster than now scheduled. Wilson wants production rate of 118,000,000 tons by the end of 1952.

▲ Agriculture Department predicted that corn crop would be 3,131,000,000 bu or 76,000,000 less than predicted one month ago. Cotton was forecast to be 17,291,000 bales or slightly greater than the previous prediction.

▲ Ore shipments on the lakes in August totaled 13,228,868 gr tons. Total to September is now 58,844,741 gr tons.

September 13

▲ According to F. W. Dodge Corp., construction awards for the month of August totaled $1,262,811,000 for the 37 states east of the Rockies.

September 14

▲ Consumption of ferrous scrap and pig iron during May totaled 11,618,209 gr tons to set a new record. Of this, purchased scrap was 3,087,313 tons, home scrap 3,009,365 tons and pig iron was 5,521,531 tons. Of this, the amount used in steelmaking furnaces was 4,448,919 gr tons of scrap, pig iron was 4,746,606 tons, or a total melt of 9,195,525 gr tons.

September 17

▲ Based on reports from companies having 93 per cent of the steel capacity of the industry, the operating rate for the week beginning September 17 is scheduled at 101.2 per cent of capacity. This is equivalent to 2,023,000 tons compared with 1,999,000 tons one week ago.

September 18

▲ Crucible Steel put back into production the blast furnace which has been down since July 1 for relining.
▲ NPA predicts that automobile manufacturers should have enough materials to build 1,100,000 cars in the fourth quarter.
▲ NPA reports structural steel requirements for the fourth quarter exceeds supplies by 233 per cent.

September 19

▲ Production of Canadian steel in June totaled 283,664 tons and for the first six months of 1950 totaled 1,763,269 tons compared with 1,650,065 tons in 1950. Pig iron production for the first six months was 1,254,140 tons.

September 20

▲ Lake Superior Iron Ore Association said that consumption of Lake Superior iron ore in August totaled 7,698,684 tons and total for the first eight months of this year was 58,883,910 tons compared with 54,796,615 tons for the first eight months of 1950.
▲ NPA hopes auto manufacturers will be able to manufacture 4,000,000 cars in 1952.

September 21

▲ Commerce Department estimates expenditures for plant expansion and equipment for 1950 will set a new record of $24,800,000,000.

September 22

▲ Interlake Iron Corp. announced a $14,000,000 plant expansion program which will increase production 23 per cent.
▲ Reserve Mining Co. will build a $75,000,000 plant to produce high grade ore for magnetic taconites. Plant will have an initial capacity of 2,500,000 tons of iron ore. It will be located at Beaver Bay, Minn.

September 24

▲ According to the AISI, the operating rate for the steel industry for the week beginning September 24 is 102.1 per cent of capacity. This is equivalent to 2,041,000 tons of steel compared with 2,023,000 tons one week ago.
▲ AISI reports employment in the steel industry in July totaled 678,200 for a new record. Average hourly wages rose to $1.955, and workers worked an average of 37.3 hr a week.

September 25

▲ H. K. Porter purchased Buffalo Steel Co. at Tonawanda, N. Y. Buffalo Steel has a capacity of 70,000 tons a year.
▲ The AISC reports that August shipments of fabricated structural steel totaled 240,072 tons. Bookings totaled 211,998 tons. Backlog for the next four months amount to 1,184,490 tons and the total backlog is 2,748,315 tons.

September 26

▲ Commerce Department reports that private borrowings increased $36,000,000,000 to $245,000,000,000 in 1950. The public debt at the end of 1950 was $239,000,000,000.

September 27

▲ The Senate voted that the corporate income tax increases be made retroactive to April 1, 1951.
▲ Westinghouse Electric Corp. announced a $296,000,000 expansion program extending beyond 1953.
▲ Colorado Fuel and Iron Corp.'s directors approved plans to sell $30,000,000 worth of bonds and $10,000,000 debentures. Proceeds will be used for new seamless pipe mill and to redeem about $14,000,000 of existing 4 per cent bonds.

September 28

▲ A meeting of steel producers and defense officials resulted in a conclusion that steel production can be increased in the first quarter of next year provided that operators can obtain enough scrap. Some steel plant repairs will probably be deferred.
▲ The Department of Commerce estimates that $24,800,000,000 will be spent on capital expenditures in 1951. In the fourth quarter of 1950 it is estimated that $6,600,000,000 will be spent compared with $6,800,000,000 in the third quarter. This expansion program would constitute about one-eighth of all the business transacted in the United States in 1952.

September 29

▲ Packard Motor Car Co. and Studebaker Corp. made an agreement to import forging billets from several Belgian steel producers.

September 30

▲ Charles E. Wilson believes enough materials will be available in the first quarter of 1952 for durable goods producers to operate on the same levels as in the fourth quarter of 1951.
▲ Defense Mobilizer Wilson expects ceiling price boosts of 2¢ to 19½¢ a lb for imported lead and to 19¢ a lb for imported zinc.

How roll necks on TIMKEN® bearings help a strip mill strip costs

THIS 4-high reversing cold strip mill is located at the Signode Steel Strapping Company in Baltimore, Md. It rolls strip at speeds up to 1200 feet per minute. Built by United Engineering & Foundry Company, the mill uses Timken® roller bearings on both the back up rolls and the work rolls. As a result, maintenance, lubrication and replacement costs are held to a minimum—trouble-free operation assured.

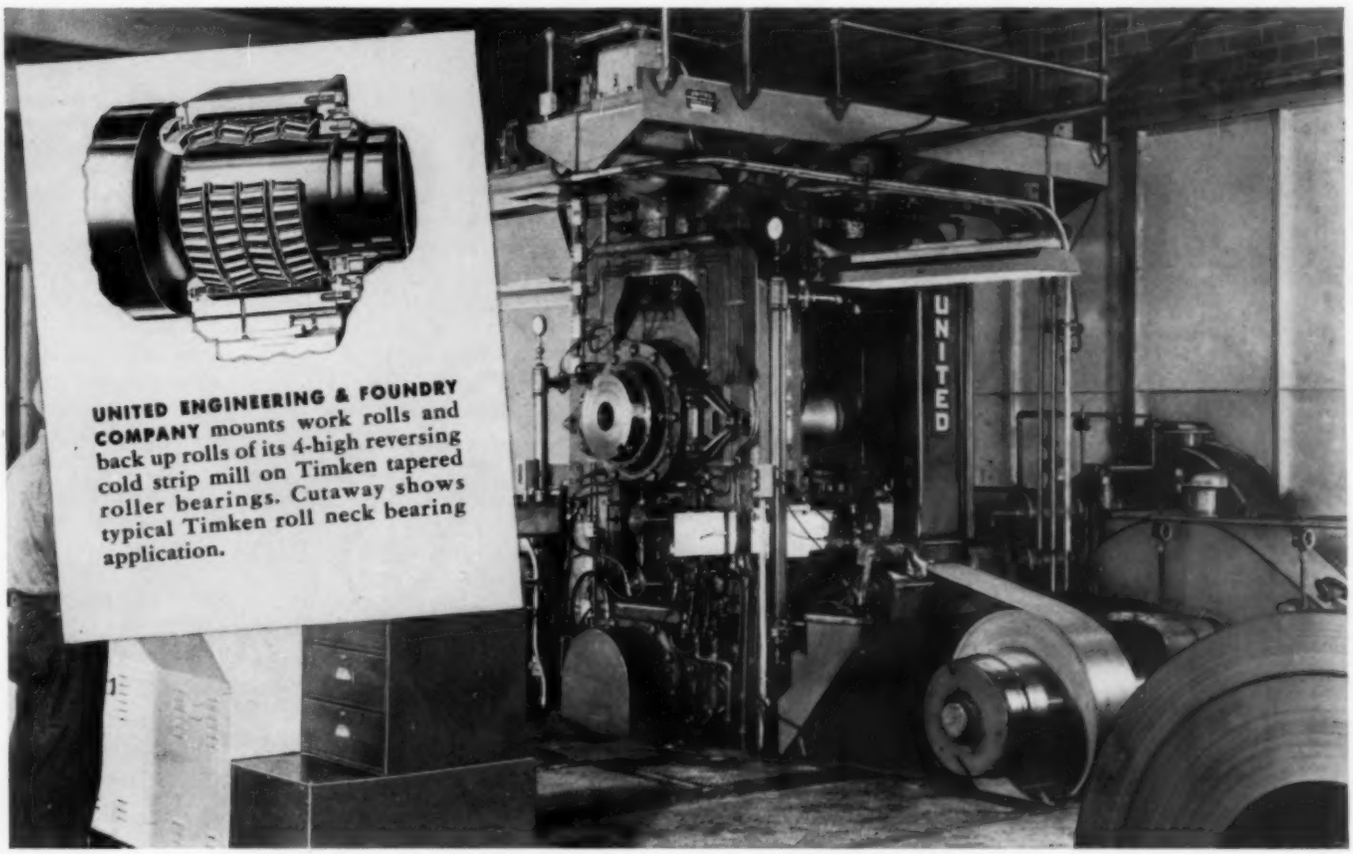
Because of balanced proportion design, Timken bearings give greater mill rigidity. Roll neck strength is increased 50 to 60%. Higher rolling speeds are possible because Timken bearings operate freely, frictionlessly.

Timken bearings permit the use of simple, economical grease lubrication. The need for costly and complicated systems is eliminated. Rolls can be changed faster, easier.

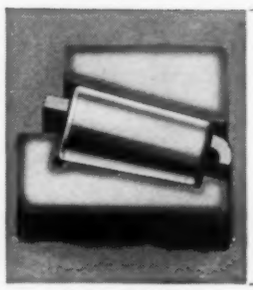
Supplementary thrust units aren't required because Timken tapered roller bearings take both radial and thrust loads in any combination. Rollers and races are case-hardened to give wear-resistant surfaces and tough, shock-resistant cores. And line contact between rollers and races means extra load carrying capacity.

You can be sure of all these advantages in either new or existing equipment by specifying Timken tapered roller bearings for work and back up rolls. Consult our roll neck bearing specialists for full details. Write The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



UNITED ENGINEERING & FOUNDRY COMPANY mounts work rolls and back up rolls of its 4-high reversing cold strip mill on Timken tapered roller bearings. Cutaway shows typical Timken roll neck bearing application.



GREATER LOAD AREA

Because the load is carried on the *line* of contact between rollers and races, Timken bearings carry greater loads, hold shafts in line, wear longer.

The Timken Roller Bearing Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

TIMKEN

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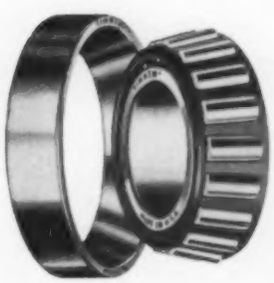
TAPERED ROLLER BEARINGS



NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ◫ AND THRUST →◫← LOADS OR ANY COMBINATION →✳←

BONNOT

INSPECTION TABLE

Greater Steel Production AT LOWER COST PER TON

Whether you have *billets or bars—rods or rails—small slabs or tubes* for inspection in your mill, a Bonnot Inspection Table will give you greater production . . . at lower cost per ton.

Used for any general inspection, or in conjunction with the Bonnot Billeteer, the Hydraulic Inspection Table is another pioneering development (proven in service) of Bonnot engineers that offers these major advantages:

1. assures faster, better inspection because inspector sees 2 faces at one time; he completes all operations from just one position, and with easy wrist motion.
2. enables inspector to work without interfering with Billeteer operator or other billet-cleaning workers and vice versa.
3. increases production because one Inspection Table can keep as many as 6 Billeteers operating at capacity.
4. segregates sizes of raw material so it can be "worked" in practical sequence; production up 15% or more.
5. available for other inspection work involving the quick, accurate and effective handling of heavy material.
6. saves machine time because inspection and marking are done in advance.
7. eliminates need of putting all material through machine; normal practice when pre-machine inspection is not provided.
8. eliminates dangerous, time-consuming hard work of floor inspection.
9. reduces accident hazards, frees storage space for other uses because material is handled more efficiently.
10. speeds "conditioning" by "sorting" material according to work—(a) surfaced completely, (b) flaws or spotting, (c) rejects, (d) no machining.

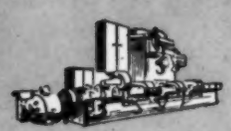
EASY! Inspection and marking flaws in billet—one side; with Bonnot Hydraulic Inspection Table, operator works easily, efficiently, safely.

FAST! Inspection and marking flaws—2 sides and corner at the same time, and within reach of operator without his changing position.

ECONOMICAL! Discharging billet forward after marking. Note unmarked billet (at lower right) awaiting placement for "practically continuous" inspection.

BONNOT WILL "ENGINEER" AN INSPECTION TABLE TO YOUR EXACT NEEDS. WRITE TODAY!

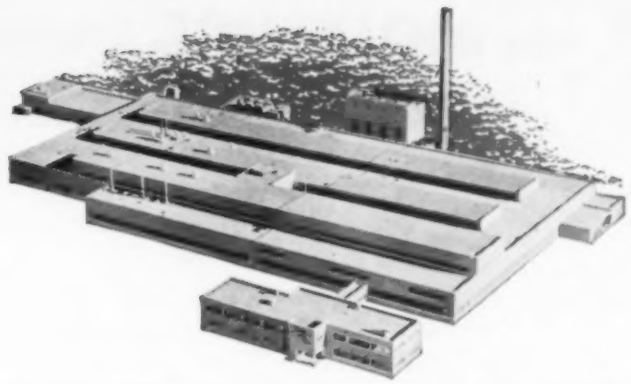
The Bonnot Co.
STEEL EQUIPMENT DIVISION
CANTON 2, OHIO



THE BILLETEER

ALSO MANUFACTURERS OF

SAWING · CRUSHING · PULVERIZING & MIXING EQUIPMENT · BILLET INSPECTION TABLES · DUST PUG MILLS · SINTER PLANT PUG MILLS



N-B-M Meadville . . . where the welcome mat is out. We're proud of this plant—its equipment and the skilled people who work in it. Proud enough, in fact, to offer a standing invitation to Blast Furnace Superintendents or other steel mill officials to visit us. When can *you* make an inspection trip?

Finished . . . with a finished touch

Here's where you'll find complete facilities for supplying copper castings with any finish specified.

Another reason why N-B-M Meadville is a name to remember when you specify copper castings. The photos above—showing copper castings in the process of being finished—typify the equipment at N-B-M Meadville . . . *complete* equipment for efficient production of castings in any degree of finish.

In these particular cases, all loose sand—both inside and out—is removed by hydroblasting, rather than rely on simply turning the casting upside down. The machined butt on N-B-M Tuyeres results in a better finish, a better fit—and more important, *helps prove soundness of the casting.*

From the molding floor to the shipping room, N-B-M Meadville accomplishes what should be, and is, the main objective of this modern, well-manned plant . . . ***What you specify . . . we ship.***

AMERICAN Brake Shoe COMPANY

NATIONAL BEARING DIVISION

4936 Manchester Avenue • St. Louis 10, Mo.

PLANTS IN: ST. LOUIS, MO • MEADVILLE, PA. • NILES, OHIO • PORTSMOUTH, VA. • ST. PAUL, MINN. • CHICAGO, ILL.

Is MOISTURE your magnet problem?

Here's an Ohio lifting magnet that operates underwater 50 percent of the time, retrieving hot crop-ends from a cooling pit. It is a standard Ohio bolted-type magnet which has not been waterproofed in any way!

This unusual application proves the extra margin of moisture protection built into every Ohio Magnet.

For longer magnet life and greater dependability, why not send your next order to Ohio—*27 years a leader in magnetic materials handling.*

Remember this picture next time you buy!

SELECT YOUR MAGNET from two Ohio types. The PROTECTO-WELD magnet, shown here, is made in 39, 46, 55 and 65-inch diameters. Bolted construction types include these and other smaller sizes.

In addition to lifting magnets and control equipment, Ohio Electric also makes fractional horsepower motors, heavy duty electric cable hoists, nail-making machines and drill presses.

THE OHIO ELECTRIC MFG. CO. • 5900 MAURICE AVENUE • CLEVELAND, OHIO

CHESTER BLAND, *President*

Ohio ELECTRIC

A-1924

Industry News...

KANSAS CITY FLOOD TESTS AVAILABLE RECONDITIONING SERVICE FACILITIES

▲ Within three weeks of the peak of the Kansas City floods, more than 1000 pieces of flooded electric apparatus had been returned to service after reconditioning in General Electric's service shop facilities in Kansas City, a company spokesman reported.

George Fiske, manager of the company's apparatus office in that city, said reconditioned equipment is being turned out of two shops at the rate of about 100 pieces of apparatus per day.

The rehabilitated equipment, he said, includes motors of various sizes, transformers, circuit breakers, control devices and other items urgently needed to help flooded industries resume full scale operations as soon as possible.

Fiske said the company's vast service engineering, manufacturing and warehouse facilities had been mobilized on an emergency basis to help speed industrial rehabilitation.

Within two days of the flood's peak, he said, skilled technicians and flood specialists — many of them with experience in the Pittsburgh, Tennessee and Ohio floods of the past — were called to emergency assignments in Kansas City from various points in the company's nationwide organization to assist the local staff.

Critically needed equipment was rushed to the scene from various G-E plants, and before the flood waters had receded, a complete new shop facility had been placed in operation. This 9000 sq ft emergency shop, which virtually doubles the company's permanent repair facilities in Kansas City, has a row of huge baking ovens, a large vacuum tank and other specialized equipment. Both shops are continuing emergency operations on a 24-hour-a-day basis.

At the flood's height, approximately 200,000 kva of 13,800-v transformers were under water, according to G-E service engineers and power company specialists on the scene. Concurrently, 160,000 hp of small and medium motors were also inundated.

G-E warehouses began rushing both renewal parts and replacements for unsalvagable equipment to Kansas City within two days after the flood reached dangerous proportions.

Production of 39 power and distribution transformers at the company's Transformer and Allied Products divisions in Pittsfield, Mass., is being speeded for early shipment. Several of these transformers will be shipped this week to Kansas City.

More than a hundred transformers have already been shipped on special rush orders from G-E warehouses and plants all over the country. These special shipments, many of which reached Kansas City before the flood subsided, were speeded by means of a telegraph tracer system, which provided step by step control of each carload of equipment.

The small and medium motor division shipped several hundred standard industrial motors to Kansas City on July 17, within 24 hours after the initial request.

The hundreds of motors sent from Lynn, as well as other industrial equipment sent by G-E plants and warehouses, were made available in the event that similar equipment in Kansas City could neither be dried nor repaired.

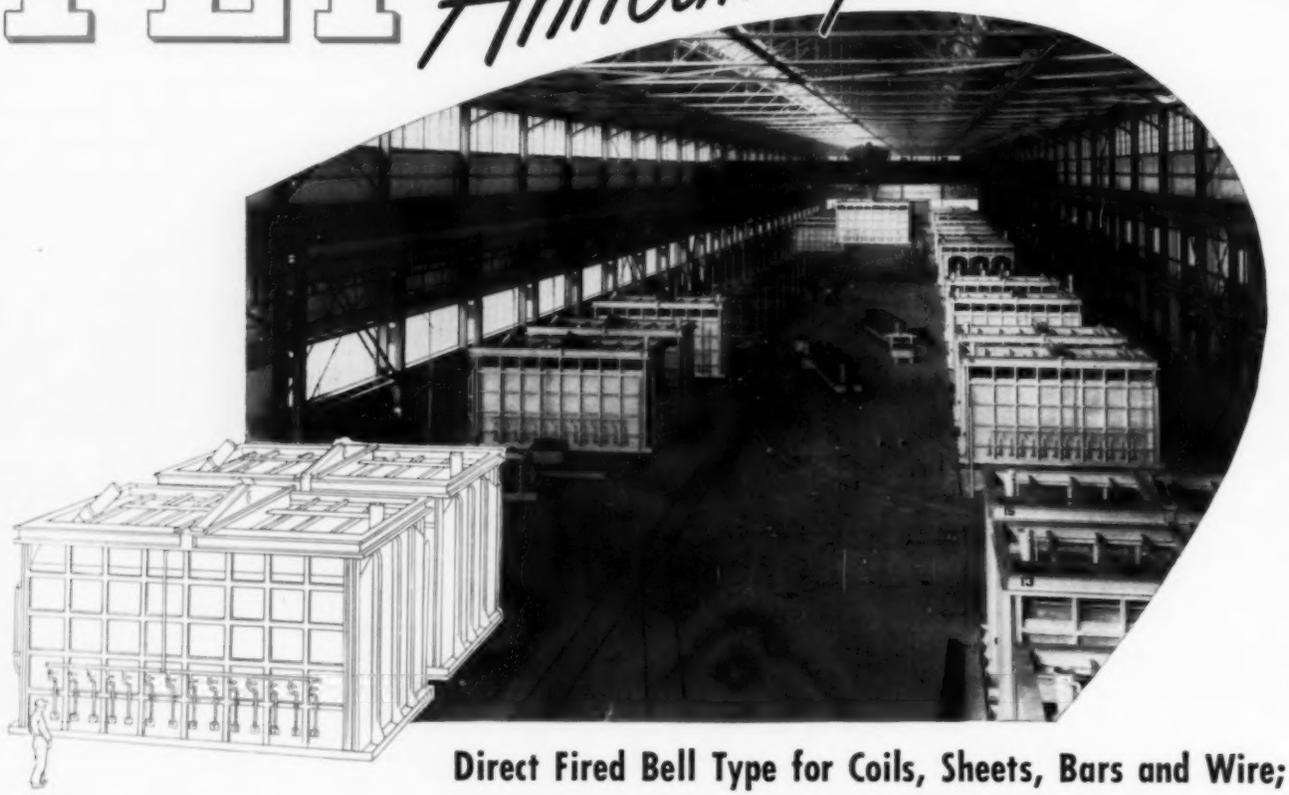
Orders placed at renewal parts warehouses and with control order service were answered within eight hours. Hundreds of coils, representing 46 different types; nearly a thousand magnetic starters, 15 different types; over a thousand heaters and a small quantity of pushbutton stations were sent from G. E.'s Schenectady, N. Y., works during this brief period.

G-E service engineers estimated that 90 per cent of the flooded electrical equipment in the area could be salvaged. The estimate was based on previous flood rehabilitation experience and an on-the-scene calculation;

VERTICAL SHEET STORAGE SAVES HANDLING

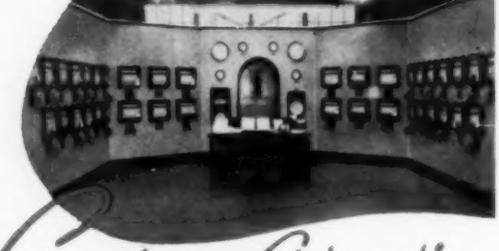
Sheet metal in this plant is now stored vertically, each kind in a separate book with steel-framed plywood covers. Index cards make finding easy. When sheets of a particular grade or size are wanted, a lifting bar, slung from the monorail hoist (right center) is hooked into the eyes of the proper book, and the complete book of sheet metal is carried to the shears or presses where the stock is required. Man-hours for handling are cut 90 per cent; floor space required for storage is halved.

F·E·I· *Annealing Furnaces*



Direct Fired Bell Type for Coils, Sheets, Bars and Wire; Complete Heating Lines for All Kinds of Armament: Guns, Armor Plate, Shells, Bombs, etc.

Fast! Efficient! Improved! F.E.I. Annealing Furnaces and Complete Armament Heating Lines are planned, engineered and built to do an outstanding job. Leaders of industry in America and abroad recognize Furnace Engineers' advanced heating methods, based on over thirty years' experience. F.E.I.'s patented, automatically controlled combustion system provides high metallurgical quality and economical operation. Consult us about improving YOUR plant's annealing performance—whether the need is for an entirely new installation or the modernization of existing furnaces.



Completely Automatic

- ***Easy to operate — even without previous experience.***
- ***Maintenance practically nil.***
- ***Minimum critical materials required.***

Photographs above show a battery of F.E.I. annealing furnaces in a large eastern steel mill; all furnaces are controlled automatically from a single Remote Control Room. F.E.I. also builds Open Hearth Furnaces, Soaking Pits, Continuous Reheating Furnaces, Forging Furnaces, and other heating lines.

Furnace Engineers, Inc.

F. E. I. Building • 1551 West Liberty Avenue • Pittsburgh 16, Pa.

AFFILIATES – *Great Britain*: Salem Engineering Co., Ltd., Milford near Derby, England; *France, Belgium, Holland, Luxembourg and Italy*: Heurtey & Co., 38 Av. G. Mandel, Paris XVI, France.

9

it was accepted by the National Production Authority and used as a ground rule for allocations during the whole emergency materials program.

ARMCO STEEL ACQUIRES LIMESTONE QUARRIES

▲ Armco Steel Corp., Middletown, Ohio, has purchased all the outstanding stock of two companies which own and operate limestone quarries at Piqua, Ohio. The two companies are Ohio Marble Co., the operating concern, and Piqua Stone Products Inc., a selling organization.

The companies have been the principal source of limestone for many years for the two blast furnaces Armco operates at its Hamilton, Ohio, plant. It is estimated that approximately 25 million tons of limestone are available on the property which consists of about 650 acres including quarries, land, and buildings.

Armco's combined needs for limestone at Hamilton and Middletown will be approximately 400,000 tons per year when the new $35,000,000 blast furnace and coke oven plant in Middletown is completed late next year.

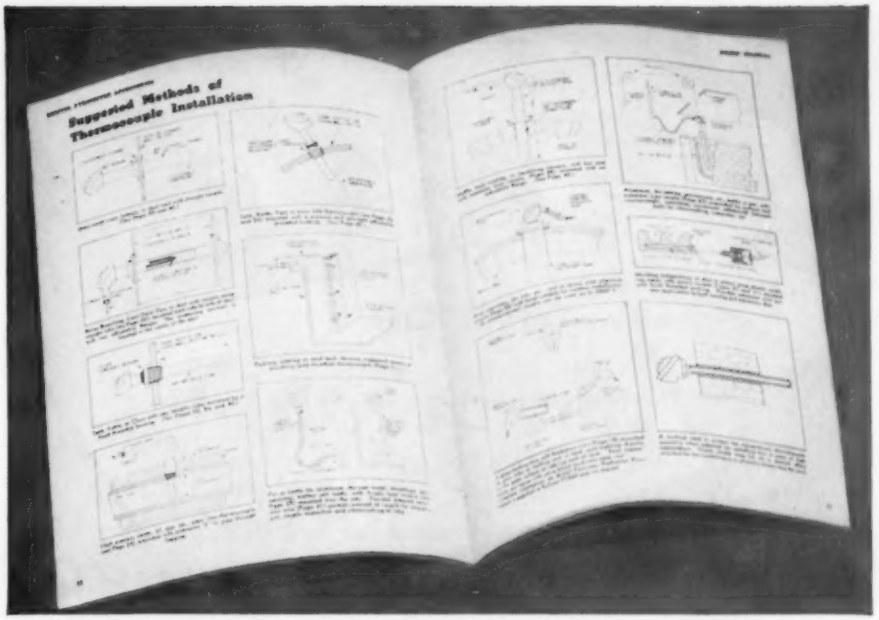
The quarries at Piqua will produce that amount of blast furnace limestone each year, in addition to about 200,000 tons of related products such as road stone, agricultural limestone, whiting for the rubber industry, and putty filler. The related products will continue to be sold to other industries as in the past.

ITALIAN FIRM BUYS ELECTRICAL EQUIPMENT

▲ Fiat Co. of Turin, Italy, largest automobile manufacturer in that country, has ordered six main drive motors and complete electronic controls from the Westinghouse Electric International Co., New York, N. Y., for a new 24-stand rod and merchant steel mill. The mill will be used for precision rolling of steel products for automobiles and airplanes.

Installation of the new mill represents a final stage in Fiat's steel expansion program for which Westinghouse is supplying large motors, controls and related electrical equipment.

The motor control system will include electronic speed regulators and field boosters to keep variations in motor speed within extremely close



NEW EDITION. Contains many new facts and suggestions—more useful information than previous editions.

THIS BOOK WILL SAVE YOU MONEY

ON THERMOCOUPLES AND PYROMETER ACCESSORIES

Put this *new* 56-page buyers' guide and users' manual to work in your plant. Write for free copy today.

Bristol's new engineering handbook makes correct selection and application of pyrometer supplies an easy matter. Lists the widest variety of thermocouple assemblies, pyrometer tubes, terminal heads, thermocouple wire and extension wire on the market. Address THE BRISTOL COMPANY, 123 Bristol Road, Waterbury 20, Conn. (The Bristol Company of Canada, Ltd., Toronto, Ont.)

Let Us Show You How You Can Save Money By Using Bristol's "Team-Up" Pyrometer Supplies Plan

You save, first, by "teaming-up" your purchases of thermocouples and pyrometer accessories to take advantage of Bristol's substantial quantity discounts.

You save, second, by having adequate reserves always on hand, thus avoiding delivery delays which might be costly.

Bristol carries stock for immediate shipment in Waterbury, Conn., Chicago and San Francisco.

BRISTOL

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

..and on
run-out tables,
too...
LOVEJOY L-R
FLEXIBLE COUPLINGS
last longer.... do the
job better!
THREE YEAR
MAINTENANCE-FREE
SERVICE RECORDS
"...three years of continuous operation of our run-out tables and not a single shut-down or break-down due to coupling failure". This statement is typical of the many made about the performance of Lovejoy Flexible Couplings. They have free-floating load cushions suspended between heavy metal jaws and cushions last two to five years. No shut-downs for changing cushions. These couplings instantly correct for mis-alignment without vibration, backlash or surge. No lubrication ever needed. For maintenance-free operation of your run-out tables and other equipment, use Lovejoy Flexible Couplings.
WRITE FOR COMPLETE CATALOG AND QUICK-FINDING SELECTOR CHARTS
LOVEJOY FLEXIBLE COUPLING CO.
5093 WEST LAKE STREET
CHICAGO 44, ILLINOIS

limits. Control will be decentralized, with a master control desk and four control sets for the roughing, intermediate and finishing sectors.

Besides six main drive motors for the finishing sector being built by Westinghouse, the Marelli Co. of Milan, Westinghouse Italian licensee, is supplying 12 motors for the intermediate sector, in capacities ranging from 750 to 1000 hp.

MINERAL WOOL STANDARDS TO ASSURE QUALITY

▲ The Industrial Mineral Wool Institute of New York announced the activation recently of an industry-wide certification program designed to assure standard quality and protect industrial users of mineral wool products. Each carton or section of insulation manufactured by the Institute's member companies will carry a label certifying that its properties exceed minimum requirements prescribed in two commercial standards issued by the National Bureau of Standards (U. S. Department of Commerce).

DETROIT STEEL AWARDS CONSTRUCTION CONTRACTS

▲ Eichleay Corp. has been awarded the contract for foundations, mechanical installations and necessary building alterations and additions for the 3 stand tandem cold mill, temper mill, continuous strip pickling line, annealing furnaces, and miscellaneous auxiliaries at the Detroit Steel Corp. plant at Portsmouth, Ohio.

CANADIAN NICKEL FIRM COMPLETES TWO PROJECTS

▲ Simultaneous completion of two projects by International Nickel Co. of Canada, Ltd., a new shaft and a new concentrator at its Creighton mine—involving total expenditures of $17,000,000 was announced recently.

The new shaft brings to 13 the number of operating shafts in International Nickel's underground mines in the Sudbury district. The new mill, which concentrates ore before transportation to the smelter at Copper Cliff, Ontario, Canada, has a capacity of 10,000 tons of ore a day. The additional underground ores will serve as replacement of open pit ores

"Tycol Apreslube cuts bearing failure... keeps production going at top speed"

That's correct! Tycol Apreslubes are extreme pressure lubricants that stand up under severe heat and moisture conditions, under tremendous loads. They inhibit rusting, and are highly stable.

Tycol Apreslube means lower lubrication costs... longer equipment service life... and positive protection against excessive gear and bearing wear.

For complete data, call or wire your nearest Tide Water Associated office.

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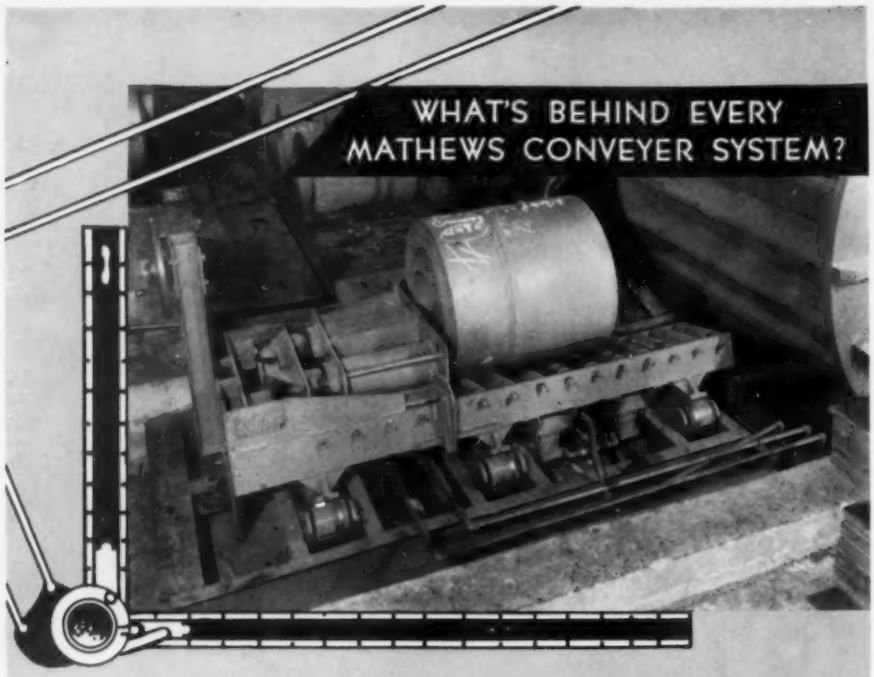
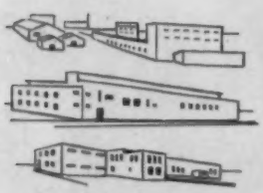
SEND FOR A FREE COPY OF "TIDE WATER ASSOCIATED LUBRICANIA"



SOUND ADMINISTRATION AND FINANCIAL RESPONSIBILITY



● When people buy a conveyer system, they buy more than just a satisfactory installation of equipment. As with every other capital investment, they are placing their confidence in the administrative ability and integrity of the company with which they are doing business.

Good business administration is a guarantee of a satisfactory installation of equipment; and, sound financial responsibility eliminates the risk of being asked to settle for a conveyer system which doesn't perform according to expectations.

Mathews Conveyer Company has, for nearly 50 years, enjoyed the reputation of being reliable and conservative; and, it has always been headed by people who believe and practice sound business methods.

To this strong administration and financial position, add the facilities of three modern plants, a large engineering staff and hundreds of skilled production people. Then you know why we can say, "If it's Mathews Equipment, it has to be right."

●

MATHEWS CONVEYERS

GENERAL OFFICES . . . . . *Mathews Conveyer Company*
ELLWOOD CITY, PENNSYLVANIA

PACIFIC COAST DIVISION . . *Mathews Conveyer Company West Coast*
SAN CARLOS, CALIFORNIA

CANADIAN DIVISION . . . . . *Mathews Conveyer Company, Ltd.*
PORT HOPE, ONTARIO

and will enable the company to continue refined nickel production capacity at the present rate of about 250,000,000 lb per year. When designed in 1948, the mill was to have a daily capacity of 6000 tons, but plans were changed two weeks after the outbreak of hostilities in Korea to accommodate the additional tonnage.

CARPENTER STEEL BUYS WEBB WIRE WORKS

▲ Purchase of the Webb Wire Works, established for 50 years in New Brunswick, N. J., is announced by Carpenter Steel Co., Reading, Pa. Webb manufactures needle wire, stainless steel spring wire, and other specialties in small diameters down to 0.0025 in.

Ernest H. Webb, president, is retiring, but continues for the time being as management consultant. Carpenter has appointed Everett F. Waltman as manager. Other personnel remains unchanged. The plant will continue to manufacture the same products for the same markets from the same location. It will be known as Webb Wire division of Carpenter Steel Co.

SELF-UNLOADING CARRIER NOW UNDER CONSTRUCTION

▲ The new self-unloading Great Lakes limestone-carrier, now under construction for the Bradley Transportation Co. at Manitowoc, Wisc., will be named the Steamer John G. Munson, in honor of the retired vice president of raw materials for U. S. Steel Corp. of Delaware.

As a vice president of the Delaware corporation, which became part of U. S. Steel Co. at the start of 1951, Mr. Munson directed the exploratory operations of the Cerro Bolivar iron ore deposits in Venezuela and the development of beneficiation methods for treating Minnesota taconite ores for U. S. Steel. He had served as president and director of the Michigan Limestone and Chemical Co. and Bradley Transportation Co. from 1928 to 1939.

The present Bradley vessel bearing Mr. Munson's name will be rechristened the Irvin L. Clymer, in honor of the company's president.

Launching of the new 666-ft Brad-

Youthful leadership plus long experience

The recent merger of Edgar E. Brosius Co., Inc. and Salem Engineering Company now offers the metals industry a keen new combination of youthful leadership backed by long experience in design and manufacture. Whether your needs include Circular Soaking Pits, Goggle Valves, Forging Manipulators, Rotary Hearth Furnaces, or a host of other furnaces and items of ferrous and non-ferrous mill equipment, you can call on this new combine with confidence. You can expect from Salem-Brosius, its Divisions and affiliates, greater depth of engineering skill to assist you in your expansion program.

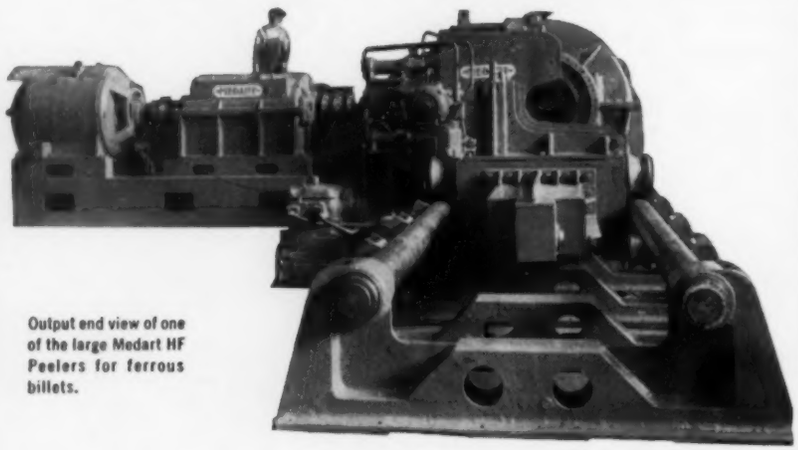
SALEM-BROSIUS, INC., Pittsburgh 15, Pa.

Affiliates: Brosius Division, Pittsburgh 15, Pa.; Salem Engineering Division, Salem, Ohio; Salem Engineering Co., Ltd., Milford nr. Derby, England; Salem Engineering (Canada) Ltd., Toronto, Canada

Billets Peeled at 20', 30', even 40' Per Minute!

MEDART

MODEL HF
BILLET PEELERS



Output end view of one of the large Medart HF Peelers for ferrous billets.

The output of Medart Billet Peelers is limited only by the capacity of the best available cutting tools! That means the absolute maximum in production at the lowest possible cost!

Built to handle both ferrous billets from 1" to 14" diameter — as well as brass, copper, aluminum and other non-ferrous metals—the throughput speeds of these Medart Peelers range from 1' to 40' per minute, depending upon workpiece size and material. They can be equipped with either one or two cutterheads—arranged for high surface finish or heaviest hogging cuts—and furnished with hydraulic or pneumatic controls, with push-pull feed devices, and for completely automatic operation.

No other scalping or turning machines made can match the production speed or economy of Medart's complete line of Billet Peelers.

Write NOW For Catalog!

THE MEDART COMPANY 3535 DE KALB STREET ST. LOUIS 18, MISSOURI

ley vessel will take place in time for the carrier to join the present six ships which now comprise the Bradley fleet early in the 1952 lake shipping season. It will be the widest cargo vessel on the lakes, with a 72-ft beam, and will have a carrying capacity of 20,000 gross tons of stone.

NATIONAL TUBE OUTPUT HITS NEW ALL-TIME HIGHS

▲ For the second time in six months, iron and steel production in plants of National Tube Co., U. S. Steel subsidiary, soared to new all-time highs in August.

The company's mills at Lorain, Ohio, and McKeesport, Pa., last month produced a total of 308,734 ingot tons of steel, bettering by more than 700 tons the record set in March this year.

Major factors in setting the new steel mark were the record production of 222,311 tons of open hearth steel in August, almost 10,000 tons ahead of the previous high, and a sharp increase from 267,665 tons to 274,470 tons in pig iron output at the blast furnaces.

AWARD CONTRACTS FOR FAIRLESS PRECIPITATORS

▲ Research Corp. has been awarded contracts by Wilputte Coke Oven division of Allied Chemicals and Dye Corp. and Arthur G. McKee & Co. cover installation of eight electrostatic precipitators at the Fairless works, Morrisville, N. J.

Each of the two new blast furnaces, which will be installed by McKee will have two Cottrell precipitators for cleaning up to 165,000 cfm of blast furnace gas.

The other four precipitators will be used to remove tar and oil from coke oven gas. Two will have capacities of 6800 cfm and two will be rated at 25,000 cfm, 90 to 120 F with a guaranteed removal efficiency of 95 per cent. The coke ovens will be installed by Wilputte.

HYATT BEARING EXPANDS MANUFACTURING PLANTS

▲ Hyatt Bearings division of General Motors Corp. has announced that preliminary plans are now complete

Bailey SINTERING PLANT PUG MILLS

PERMIT A *more uniform,*
***better grade of* SINTERED PRODUCT**

Through thorough mixing and fluffier material, the Bailey Sintering Plant Pug Mill produces a *better* sintered product. With this machine, a higher bed can be used without increasing the wind box vacuum. The result is greater tonnage of more uniform, better grade materials.

These mills can be built to any desired capacity, direct or rope drive, single or double shaft.

Send for new bulletin giving full information on all Bailey Pug Mills.

WILLIAM M. Bailey COMPANY
ENGINEERS
LEADERSHIP THROUGH QUALITY
1221 BANKSVILLE ROAD PITTSBURGH 16, PA.

ELIMINATE
STEEL HANDLING
BOTTLE NECKS

ROSS Series 100 CARRIER

...simplest mass handling method known!

Now... you can move 45,000-pound payloads of billets, bars, plate, in-process and finished steel *where* you want them *when* you want them... at a moment's notice!

Now... you can be free of the restrictions of a plant railroad handling system... its expensive trackage, cars, locomotives... costly, time-consuming switching operations!

Now... you can prevent congestion in the mill... free more mill space for production operations... eliminate costly re-handling ... save time and money in getting out current orders!

How? With Ross Series 100... the *only* Carriers designed and built all the way through for rough, tough steel mill service... the *only* Carriers with that great reserve strength steel men demand. Self-loading and unloading, Ross Series 100 requires only a driver... and moves capacity loads at speeds up to 33 mph.

Don't overlook the outstanding advantages of the Ross Carrier Steel Handling Method... ASK STEEL MEN WHO *KNOW!* Get full details on Ross Series 100 Carrier... a 'phone call, wire or letter will do it.

Rely On ROSS

THE ROSS CARRIER COMPANY

Direct Factory Branches and Distributors Throughout the World

400 Miller St., Benton Harbor, Michigan, U.S.A.

for expansion of the manufacturing areas in the Hyatt plants in both Harrison and Clark Township, N. J.

Increasing demand for roller bearings in the National Defense Program has necessitated this expansion of manufacturing facilities.

New structures at the Clark Township plant will provide an additional 390,000 sq ft of floor space doubling the existing facilities.

Alterations to the Harrison plant will provide an additional 12,000 sq ft of manufacturing area.

The present expansion program at the Harrison and Clark Plants is the largest in Hyatt's history. The new areas provided will be used exclusively for bearings for the defense program.

Plans for the new structure have been prepared by the Argonaut Realty division of General Motors and it is estimated that ten months will be required to complete the project. The start of actual construction will depend upon the availability of material.

TOOL FIRM ORGANIZED IN PITTSBURGH, PA.

▲ Rite-Way Tool Co. has been organized by Oliver B. Schmeltz and Thomas M. Rees to market standard and special metal cutting tools and machine tool accessories. Headquarters of the new company will be located at 1612 Potomac Avenue, Pittsburgh, Pa.

Rees Machinery Co. will continue to function as heretofore in the Empire Building, Pittsburgh, Pa.

CONSTRUCTION BEGINS ON TEXAS ALUMINUM PLANT

▲ Construction work on the new Aluminum Co. of America aluminum smelting plant at Rockdale, Tex., is scheduled to begin this month.

John D. Harper, who has been assistant district power manager for Alcoa's Tennessee operations, has been named works manager for the company's Rockdale plant. Len B. Neubert has been appointed construction superintendent for erection of the new aluminum smelting plant, having been transferred from the company's works at Vancouver, Wash.

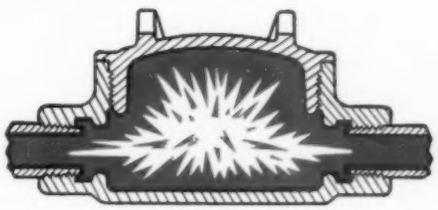
It is expected that the metal-producing facilities at Rockdale will be in partial operation late in 1952.

Explosion-Proof CONDULETS*

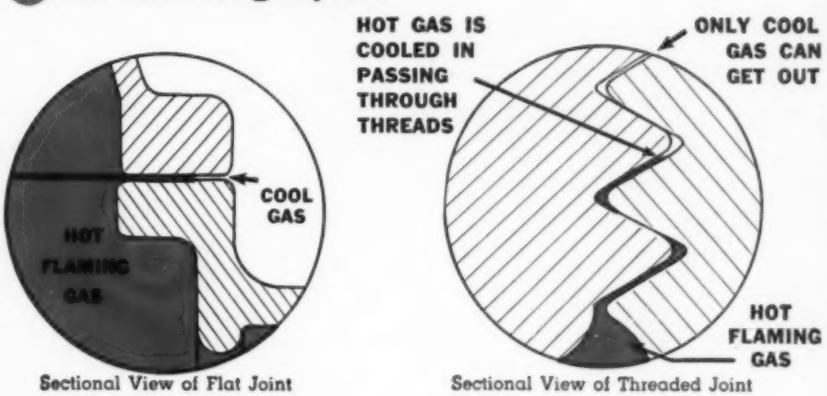
give you PROTECTION where flammable atmospheres are present or likely to be present

. . . because every explosion-proof CONDULET . . .

1 Withstands the force of an internal explosion



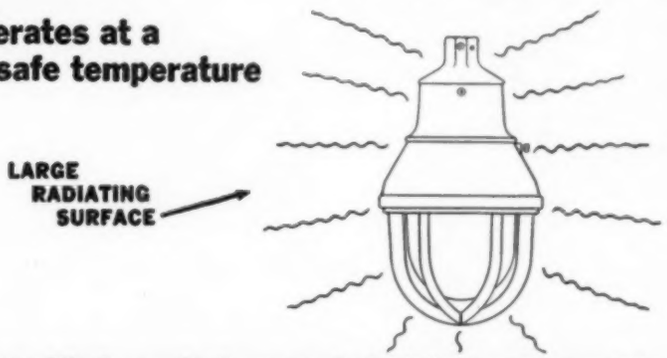
2 Has flametight joints



Sectional View of Flat Joint

Sectional View of Threaded Joint

3 Operates at a safe temperature



All Crouse-Hinds explosion-proof electrical equipment is built to exceed Underwriters' Laboratories requirements.

Thousands of explosion-proof and dust-tight CONDULETS are listed in Crouse-Hinds CONDULET Catalog.

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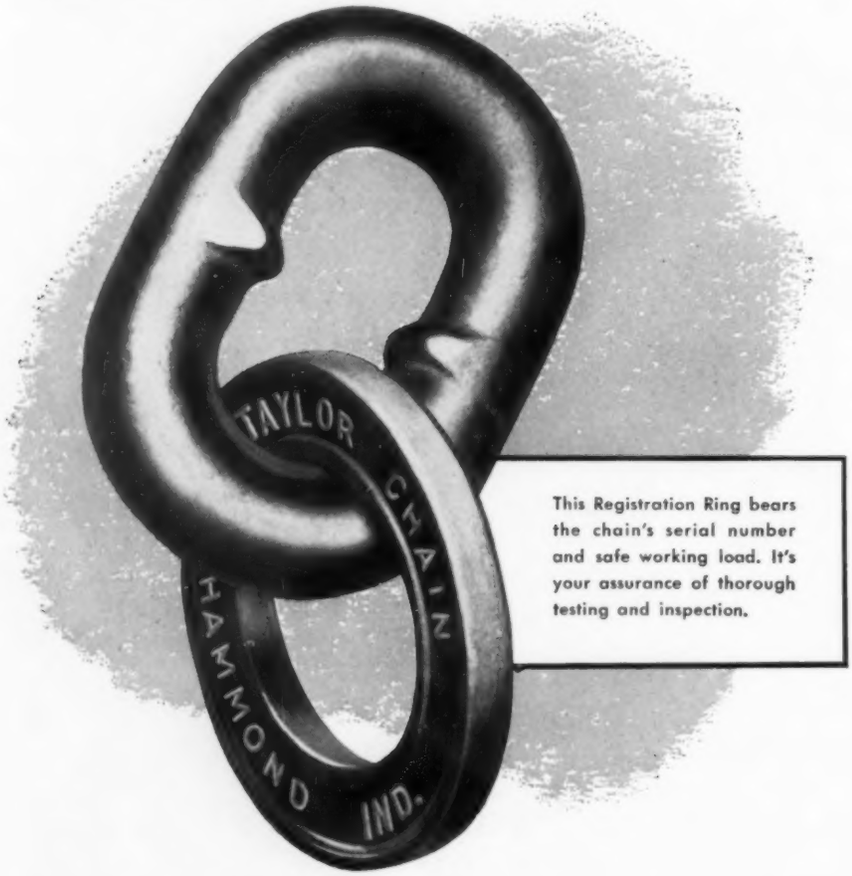
CONDULETS · TRAFFIC SIGNALS · AIRPORT LIGHTING · FLOODLIGHTS

TM Alloy Steel CHAINS

DO MORE WORK, LAST LONGER,

COST LESS . . . THAN WROUGHT IRON TYPES



This Registration Ring bears the chain's serial number and safe working load. It's your assurance of thorough testing and inspection.

Your chain problems are substantially reduced when you buy TM Alloy Steel Chain. Records prove this famous chain *outlasts* and *outperforms* wrought iron types . . . even under the toughest conditions. It's more economical too!

TM Alloy Steel Chain has twice the tensile strength. Controlled heat-treatment assures a uniform hardness of from 265 to 285 Brinell. These features make it highly resistant to abrasion, cold-working, grain growth and shock at all temperatures.

Send for free booklet containing all the facts and specifications on TM Alloy Steel Chain and attachments.

S. G. TAYLOR CHAIN COMPANY
Dept. 5, Hammond, Indiana
Rush literature and prices on TM Alloy Steel Chains.

NAME _____

ADDRESS _____

TAYLOR MADE
A GREAT NAME IN
Chain SINCE 1873

When full operation is reached in 1953, a total of approximately 1000 persons will be employed by the company at the plant. The aluminum production capacity of the plant will be in the neighborhood of 170,000,000 lb annually.

The large quantities of electric power required for the operation of the plant will eventually be provided by generating facilities to be erected adjacent to the aluminum plant. The power plant will be designed, constructed and operated for Alcoa by the Texas Power & Light Co. It will be the first aluminum smelting plant in the nation to use electric power generated by burning lignite for fuel.

The lignite will be mined in Milam County, in the vicinity of the power plant. Mining operations will be conducted by the McAlester Fuel Co. Alcoa will acquire ownership of the Rockdale, Sandow & Southern Railroad from the McAlester Fuel Co., and will operate it.

DRAVO ADDS NEW SHOPS FOR CRANE CAB SERVICE

▲ Increasing number of air conditioning installations for commercial, institutional and industrial buildings throughout Western Pennsylvania, has resulted in the opening of new shop facilities for this work by Dravo Corp. The new facilities were formally opened September 19 at 3901 Second Ave., Pittsburgh, Pa.

With a total of 19,500 sq ft of floor area, the new shop will include fabricating and welding facilities for servicing and maintaining air conditioning and combustion systems.

The shop also will provide enlarged manufacturing space for producing Dravo crane cab coolers, small air conditioning units used on cranes operating in hot atmospheres.

H. K. PORTER PURCHASES BUFFALO STEEL CO.

▲ H. K. Porter Co., Inc., Pittsburgh, Pa., has acquired the Buffalo Steel Co., Tonawanda, N. Y., producers of light steel products, it was announced by T. M. Evans, president.

With the acquisition of this company and Connors Steel Co., Birmingham, Ala., last October, Porter now has a total speed production capacity exceeding 200,000 tons. Buffalo Steel Co. with a total capacity of more than

Exide-Ironclad
BATTERIES

ARE YOUR BEST POWER BUY— AT ANY PRICE

They ASSURE high maneuverability of trucks . . . rapid, accurate handling of material . . . PROVIDE uniform rate of material handling with no unscheduled down time. SHOW lowest costs of operation, maintenance, repair, depreciation . . . inherently safe. Call in an Exide representative, and let him prove these facts.

THE ELECTRIC STORAGE BATTERY COMPANY
Philadelphia 2

Exide Batteries of Canada, Limited, Toronto

"Exide-Ironclad" *Reg. Trade-mark U. S. Pat. Off.*

Torrington 4-housing Swinging Coiler installed by the Miller Co., Meriden, Conn.

For coiling the thick gauges and the hard alloys of phosphor bronze and other non-ferrous alloys, the Miller Company prefers their Torrington 4-housing Swinging Coiler. Delivering tight coils, taking the toughest metals within its range, this coiler gives dependable, trouble-free service.

FEATURES OF TORRINGTON 4-HOUSING SWINGING COILER

Designed for .100" to .325" gauges, non-ferrous metals
Cartridge-type coiling roll boxes for easy roll removal
Farval centralized lubricating system
Kick-off and tailing mechanism
Motorized traverse to track with mill roll face
Readily swung to non-operating position
Parallel adjustment of top coiling rolls
Double helical steel gears running in oil

Torrington manufactures a wide range of 2- and 4-housing coilers in portable, stationary, sliding and swinging models. Torrington skill, knowledge and experience, gained from years of close collaboration with metal mills, is available to you in selecting or adapting the correct model for your specific problem.

Call or write Torrington for information and name of nearest Torrington representative.

The TORRINGTON
MANUFACTURING COMPANY • TORRINGTON, CONNECTICUT

DESIGNERS AND BUILDERS OF MILL MACHINERY FOR SIXTY-FIVE YEARS

70,000 tons a year, is a leading manufacturer of light steel products, producing concrete reinforcing bars, agricultural shapes, fence posts, shelving angles, merchant bars and other similar steel products. Connors manufactures products similar to Buffalo Steel, and in addition produces electric furnace steel.

The acquisition of Buffalo Steel serving the northern market, Mr. Evans pointed out, forms a quite natural combination with Connors Steel serving the South. Other Porter products include industrial rubber products, high voltage electrical equipment, oil field equipment and industrial and railroad springs.

PITTSBURGH STEEL BUYS THOMAS STEEL CO.

▲ Pittsburgh Steel Co. has completed purchase of the eight-million-dollar Thomas Steel Co. of Warren, Ohio. Acquisition of Thomas marks the first step of Pittsburgh Steel into the flat rolled products field. This will be supplemented in 1952 when Pittsburgh Steel enters the sheet market with completion of a 66-in. mill at Allenport, Pa.

The Warren company will be operated as the Thomas Strip division of Pittsburgh Steel Co.

Thomas manufactures uncoated cold rolled strip, electro-coated and hot dipped coated strip, alloy strip and spring steel. Its plant has 300,000 sq ft of floor space and is located on a 160-acre tract.

Acquisition by Pittsburgh Steel was accomplished through an exchange of stock. Pittsburgh Steel last month increased its common stock to 1,500,000 shares, part of which was used to acquire Thomas.

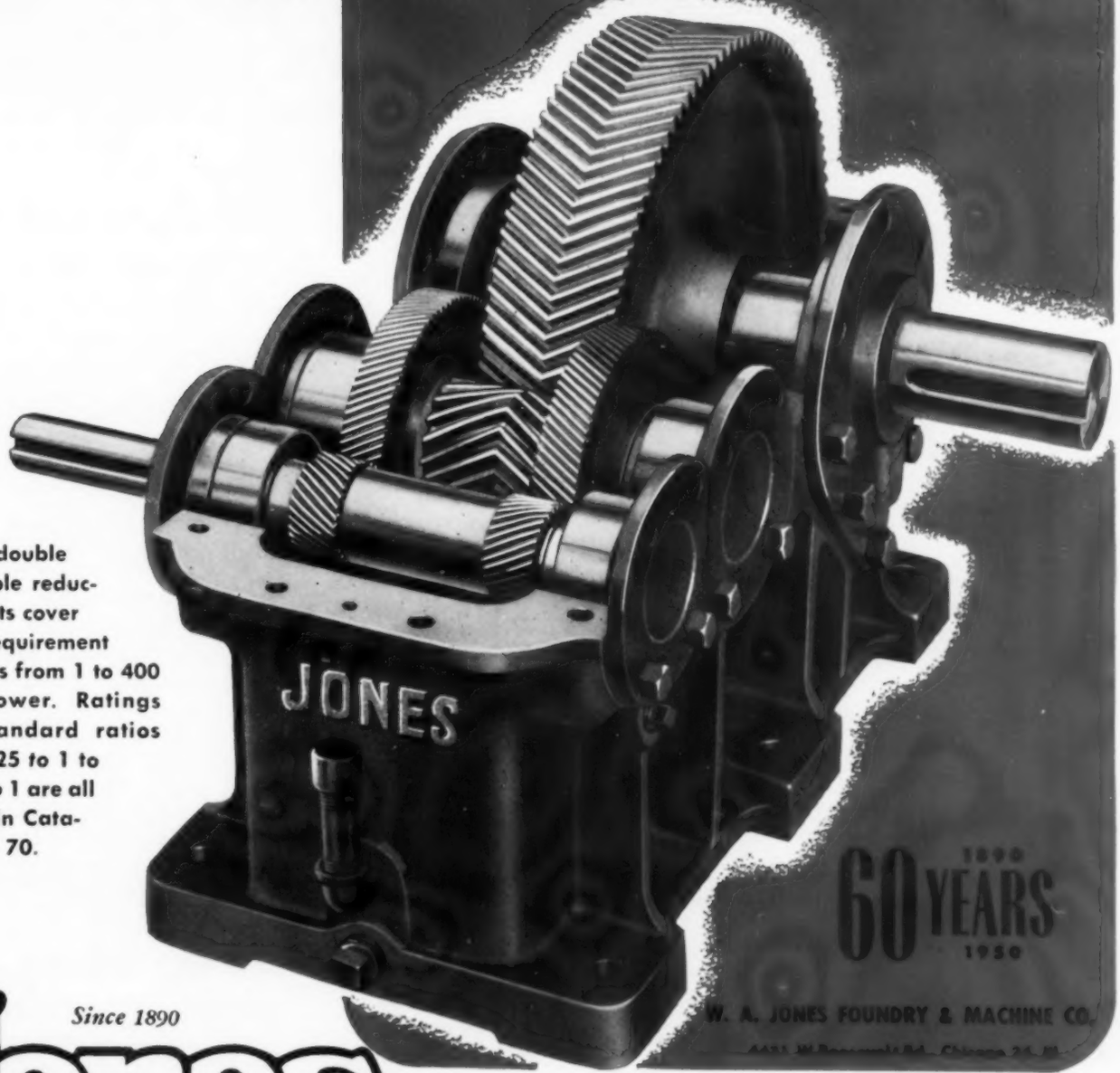
HYDROPRESS GETS ORDER FOR PHILIPPINE MILLS

▲ Hydropress, Inc., has announced that the Loewy rolling mill division has received an award for a steel mill from the National Shipyards and Steel Corp., Engineer Island, Manila, Philippines, an agency of the Philippine Government. The award covers the supply of a complete merchant and structural mill installation including all mechanical and electrical equipment as well as the furnaces, valued at approximately $2,000,000.

For the proper solution of the many

Jones

Herringbone SPEED REDUCERS



Single, double and triple reduction units cover every requirement in drives from 1 to 400 horsepower. Ratings and standard ratios from 1.25 to 1 to 355.8 to 1 are all shown in Catalog No. 70.

1890 60 YEARS 1950

W. A. JONES FOUNDRY & MACHINE CO.

Since 1890

Jones

In The Service Of Industry

HERRINGBONE — WORM — SPUR — GEAR SPEED REDUCERS
CAST IRON PULLEYS • CUT GEARS • V-BELT SHEAVES
ANTI-FRICTION PILLOW BLOCKS • FLEXIBLE COUPLINGS

THIS IS THE TIME TO

SAVE PICKLING ACID!

STANDARD PICKLING PRACTICE THE WORLD AROUND

CHEMICALS ACP PROCESSES

Here are some ways to pickle more steel with less acid:

1. IMPROVE THE EFFICIENCY OF YOUR PRACTICE

Use every available pound of acid before dumping, by:

a. Operating baths until more than the usual amount of iron accumulates,

b. Stopping the additions of acid sooner than usual,

c. Offsetting the slower pickling by raising bath temperature to boiling,

d. Lengthening pickling time for last one or two batches.

Do not, if possible, dump bath with as much acid content as previously. Dump only when bath fails to work after above recommendations have been followed.

2. IMPROVE THE CHEMICAL EFFICIENCY OF YOUR PICKLING

Utilize every available pound of acid before dumping, by:

a. Increasing the proportion of "RODINE"® in the bath up to 1% by volume of the acid.

The increased amount of "RODINE" will:

a. Save the acid now needlessly wasted dissolving good metal,

b. Retard from build-up, thus saving acid by reducing number of times tanks must be dumped.

Write for further information on saving pickling acids.

Pioneering Research and Development Since 1914

AMERICAN CHEMICAL PAINT COMPANY

AMBLER, PA.

Manufacturers of Metallurgical, Agricultural and Pharmaceutical Chemicals

problems presented by the special conditions connected with this mill installation, the engineering specialists of Hydropress have developed an entirely new plant arrangement which has been fully approved and accepted.

The mill installation comprises an 18 inch and a 12 inch mill to accommodate the wide range rolling program of structurals, bars and merchant products, as well as all necessary auxiliary machines. An essential feature of this installation is an automatic mechanical cooling bed of latest Loewy-Hydropress design, capable of servicing the entire mill output.

BLAST FURNACE GROUP TO MEET IN CLEVELAND

▲ The Eastern States Blast Furnace and Coke-Oven Association announces a joint meeting with the Blast Furnace and Coke Association of the Chicago district at Hotel Statler, Cleveland, Ohio on November 2.

KOPPERS TO BUILD OVENS IN SYDNEY, NOVA SCOTIA

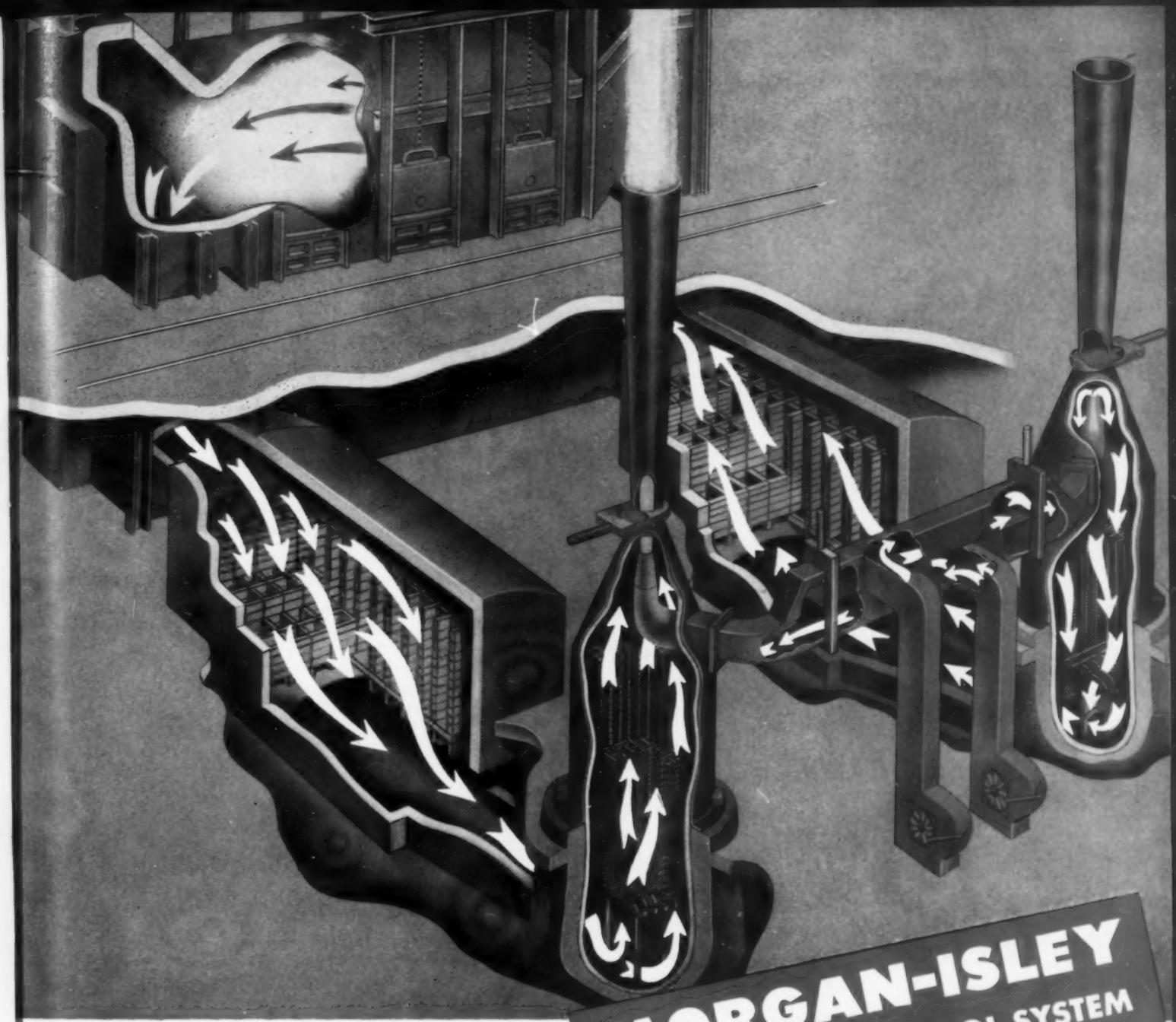
▲ Dominion Steel & Coal Corp., Ltd., of Sydney, Nova Scotia, has awarded a contract for engineering and construction of a battery of 61 new chemical-recovery coke ovens to Koppers Co., Inc.

Of latest Koppers-Becker underjet design, the new battery will carbonize about 1400 net tons of coal per day, the ovens being heated by coke oven gas which will be recirculated. An old 60-oven battery will be torn down and the new battery built on this site.

About two years ago Koppers completed and put into operation for Dominion a 53-oven battery. When the new battery is completed, early in 1953, it and the 53-oven battery of recent design will produce as much coke for Dominion as three old 60-oven batteries. The new battery will replace two 33-year old batteries presently in operation.

VAN PELT ELECTRIC MOVES PITTSBURGH OFFICE

▲ Van Pelt Electric Co., formerly located at 105 Fahnestock Road, Pittsburgh 15, Pa., has moved to a new location. The address is now P. O. Box 7808, Pittsburgh 15, Pa.



MORGAN-ISLEY
COMBUSTION CONTROL SYSTEM

Now, an even more efficient

The Morgan-Isley has been proven vastly superior to the conventional natural draft system . . . in original cost, fuel savings, output, quality, maintenance cost . . . in every way.

Now the Morgan-Isley has been redesigned to permit much larger secondary checkers that trap more heat, supply hotter combustion air and make better use of fuel.

Write for our new bulletin today.

MORGAN WORCESTER

CCC-30

MORGAN CONSTRUCTION COMPANY WORCESTER, MASS.

ROLLING MILLS • MORGOIL BEARINGS • REGENERATIVE FURNACE CONTROLS • EJECTORS • PRODUCER GAS MACHINES

PITTSBURGH, PA., 2815 Koppers Bldg. *English Rep.*, International Construction Co., 56 Kingsway, London W. C. 2, England

INSTRUMENT COMPANY CONCLUDES 1951 COURSES

▲ Brown Instrument division of Minneapolis-Honeywell Regulator Co. has this year concluded several special courses for different groups of its own and customer personnel. The company included courses in late spring and early summer for a group of more than 100 newly graduated engineers that have been added to the Brown staff. It has just closed a seminar, the second in two years, for the faculties of colleges and technical schools.

Specialized instruction conducted by the company or sponsored by other organizations includes a course in nuclear engineering to be held in September by the Atomic Energy Commission. The Brown division is one of seven organizations whose engineers will take the course. The company and its valve division cooperated in a course sponsored in Philadelphia by the Management Service Division of Temple University's Community College and Technical Institute. The Radio Corp. of America provided instruction for that course.

On September 17 the Brown division will start the first semester of its 1951-52 courses in industrial instrument maintenance and repair. This course, conducted annually for more than a decade at the Brown School of Instrumentation at Philadelphia, Pa., will continue to December. That and the second semester, starting in January, will include a 13-weeks comprehensive course concurrently with the shorter classes. As in the past, these courses will be for the benefit of customer and Brown personnel.

Added to these programs is another which is providing printed and other material for those colleges and schools conducting and introducing industrial instrumentation as a part of their regular curricula. It is expected that as defense, customer and its own requirements demand that further instruction and indoctrination will be conducted by the company and that advantage will be taken of important courses initiated by other organizations and the government.

Instruction in Brown's yearly classes is being made available to enlisted and officer personnel of the military and for members of various government defense agencies. In addition, special instruction is being provided for students from friendly foreign countries.

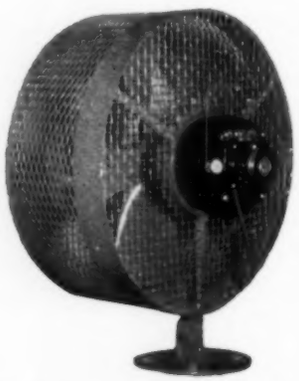
RUST TO ENGINEER ITALIAN HEATING UNITS

▲ Rust Furnace Co. will design and furnish engineering services and appurtenances for two ingot heating furnaces to be installed in an Italian mill, under contract with Hydropress, Inc.

The triple-fired furnaces are being designed by Rust for a capacity of 16½ tons per hour to deliver ingots at a temperature of 2300 F.

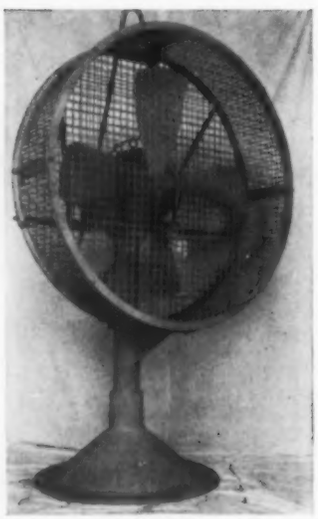
Of the recuperative type, the Rust heaters will be equipped with three-zone automatic temperature and automatic furnace pressure controls.

IS HEAT SLOWING UP YOUR WORKMEN?



TRUFLO CRANE CAB FANS
For cooling interiors of crane cabs and other confined areas. Adjustable both horizontally and vertically. Four blade type, 12 and 18 in. sizes.

Keep them COOL with TRUFLO FANS



TRUFLO PORTABLE COOLING FANS
Easily portable. Help keep efficiency high where work is hottest. 12 to 36 inch diameters.

Production suffers when workmen are overheated. Steps begin to drag, efficiency falls.

Now, when speedy production is vital, Truflo Fans can help keep your workmen on their toes. All Truflo Fans are designed and built correctly to put fresh cool air *in large volumes* exactly where it is needed. Perfectly-balanced shafts and blades give more air per h.p. . . . strong steel frames stand up longer under hard use . . . rugged wire guards protect men against injuries.

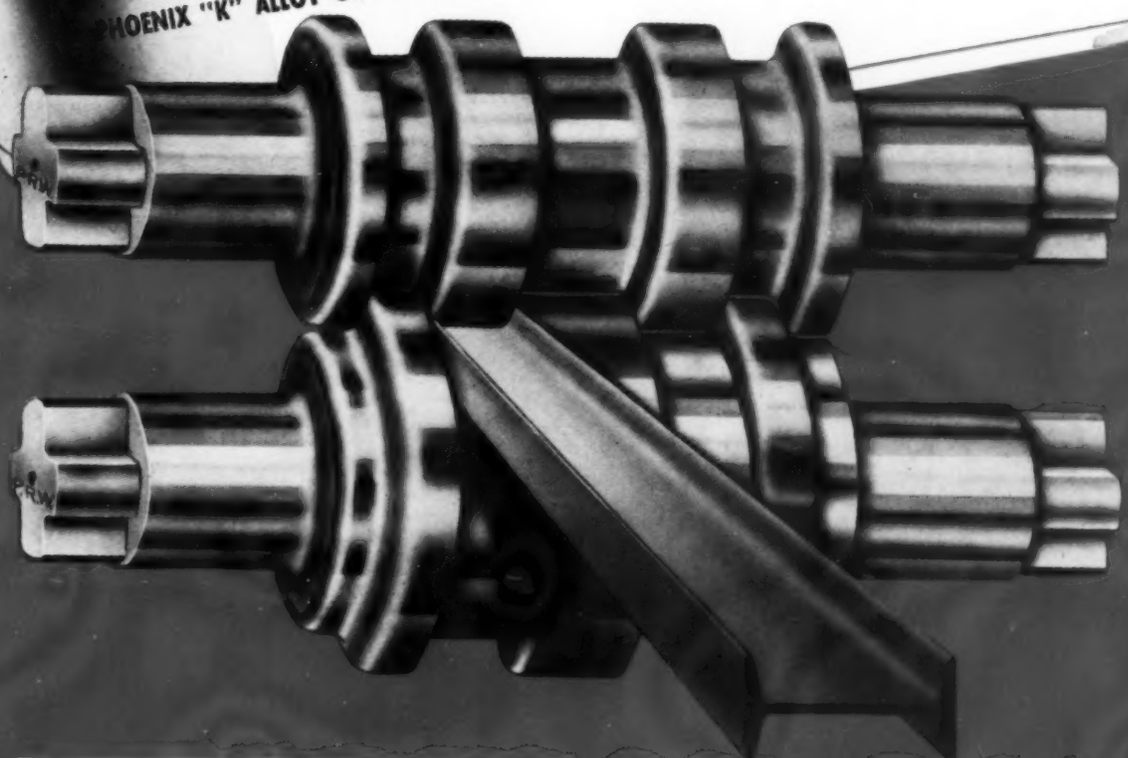
All of the following types can help beat the heat, keep production moving in your plant. Write for illustrated literature.

PORTABLE COOLING FANS
CRANE CAB FANS • WALL FANS
EXHAUST FANS • BLOWERS
ROOF VENTILATING FANS
PENT HOUSE FANS

TRUFLO FAN COMPANY
245 MAIN ST., HARMONY, PA.

ROLLS for ROLLING BEAMS

There's a definite PHOENIX ROLL for each ROLLING requirement



P.R.W.

PITTSBURGH ROLLS

PITTSBURGH ROLLS DIVISION OF BLAW-KNOX COMPANY · PITTSBURGH, PA.

"NO MORE STOOL STICKERS... SINCE WE STARTED USING NATIONAL TRADE-MARK GRAPHITE STOOL INSERTS!"

WRITE TO NATIONAL CARBON COMPANY FOR INFORMATION.

The term "National" is a registered trade-mark of Union Carbide and Carbon Corporation

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A Division of Union Carbide and Carbon Corporation
30 East 42nd Street, New York 17, N. Y.
District Sales Offices: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco
IN CANADA: National Carbon Limited
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Other ***NATIONAL CARBON*** *products*

BLAST FURNACE LININGS • BRICK • CINDER NOTCH LINERS • CINDER NOTCH PLUGS • SKIMMER BLOCKS • SPLASH PLATES • RUNOUT TROUGH LINERS • MOLD PLUGS • TANK HEATERS

Personnel News...

James Farrington has been appointed special assistant to chief plant engineer of the Steubenville, Ohio, works, Wheeling Steel Corp. Mr. Farrington had been electrical superintendent for many years. **George Merrick** was named electrical superintendent and **Henry Ford** becomes assistant electrical superintendent.

Riley R. Clark has been appointed superintendent of industrial relations at United States Steel Co.'s South Chicago, Ill., works. Mr. Clark has been assistant superintendent of industrial relations at the South Chicago plant since 1947.

Chester W. Bruce was appointed chief engineer for the Chicago, Ill., district of Republic Steel Corp. He succeeds **Alvin A. Claassen,** who retired recently after 34 years' service with the company. Succeeding Mr. Bruce as assistant chief engineer is **Harold E. Berg.** Mr. Bruce has served as Chicago district chairman of the Association of Iron and Steel Engineers. At present he is serving as a national director on the Association's board of directors.

Harrison Webb has been appointed superintendent of the new strip mill to be constructed at the Allenport, Pa., works of the Pittsburgh Steel Co. Prior to coming with Pittsburgh Steel, he was employed at the Warren, Ohio, plant of Republic Steel Corp. in a supervisory capacity in the strip rolling department.

John D. Paulus, former account executive of Ketchum, Inc., and a veteran of 20 years on Pittsburgh, Washington and New York newspapers, has been appointed director of public relations of the Jones & Laughlin Steel Corp., Pittsburgh, Pa. He succeeds **Earl F. Blank,** who becomes special assistant to vice president—employe and public relations.

John E. Groves was appointed as director of industrial relations and **Ralph L. Ostrander** as manager of labor relations for Allegheny Ludlum Steel Corp., Brackenridge, Pa. Mr. Groves, a native of Pittsburgh, has been manager of industrial relations of the New Holland Machine division of Sperry Corp. for the past three years. He had previously been employed in industrial relations by National Radiator Co. and Standard Steel Spring Co. Mr. Ostrander, who joined the company in 1945 as assistant director of personnel, has recently served as acting head of the industrial relations department. He previously had worked in personnel and industrial relations in the coal mining industry. Both men will make their headquarters at the company's general offices at Brackenridge, Pa.

Alex L. Gresham has been appointed division metallurgist for standard practices in the metallurgical department of the American Steel & Wire Co., Cleveland, Ohio.

Wallace B. Quail was appointed as director of the Iron and Steel division, National Production Authority, U. S. Department of Commerce. Mr. Quail is on leave from his post as manager of the central area for Armco Steel Corp.

Joseph W. Gray has been appointed division metallurgist for wire at the Joliet, Ill., works of the American Steel & Wire Co.

Hurschel I. Arrington was appointed superintendent of the slabbing mill and soaking pit at Lone Star Steel Co., Dallas, Texas. Mr. Arrington was formerly blooming mill superintendent at Gadsden, Ala., works of Republic Steel Corp. **Stephen J. Kuchta** has also joined the staff of Lone Star Steel. Mr. Kuchta will be assigned a supervisory position in the pipe mill. He formerly was employed by American Cladmetals, Crucible Steel Co. of America, and McLouth Steel Corp.

E. M. Barber, formerly president of Thomas Steel Co., Warren, Ohio, was elected executive vice president and director of Pittsburgh Steel Co. Pittsburgh Steel recently acquired Thomas Steel Co. **C. H. Lewis,** former Thomas board chairman will have an active part in management affairs of Pittsburgh Steel, with his office at Warren. **George C. Floyd** will continue as works manager of the strip division.

M. D. Conroy, vice president in charge of industrial relations for Granite City Steel Co., Granite City, Ill. retired. Mr. Conroy is being retained by the firm to be called in from time-to-time in an advisory and consulting capacity. **John R. Hundley,** director of personnel at Granite City has been named director of industrial relations and personnel.

JAMES FARRINGTON

RILEY R. CLARK

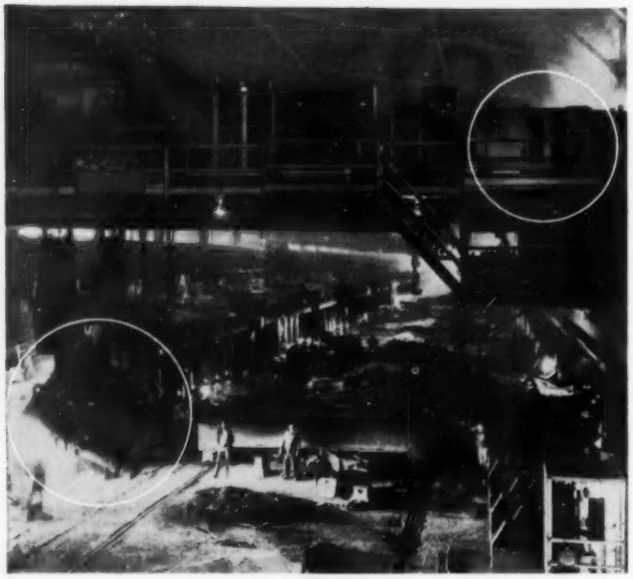
CHESTER W. BRUCE

HAROLD E. BERG

LARGE TUBE MANUFACTURER *Uses* **DRAVO**

CRANE CAB COOLERS

IN OPEN HEARTH OPERATIONS



CAB TEMPERATURE REMAINS CONSTANT; DUSTS, FUMES, GASES, DIRT ELIMINATED

In open hearth charging operations, crane cab operators are subject to heat from 135° to 150° F., plus such nuisances as dusts, fumes, gases and dirt. To eliminate such unpleasant working conditions, this large tube manufacturer has installed Dravo Crane Cab Coolers on open hearth charging cranes.

Results: cab temperatures constant at 80° to 85° F., winter or summer; healthier workers and more efficient operations.

CRANE CAB COOLERS HAVE LONG SERVICE LIFE, PROVIDE YEAR-'ROUND AIR CONDITIONING

Dravo Crane Cab Coolers are ruggedly constructed, factory assembled and pretested to provide years of more-than-satisfactory service. All equipment in the unit is readily accessible with ample space for quick and efficient maintenance.

In the various air conditioning functions the crane cab cooler not only filters the air, removes dust, dirt and fumes, but heats the cab in winter, cools it in summer and provides constant ventilation the year around.

AVAILABLE IN SINGLE UNIT OR IN SPLIT-TYPE UNIT; IMMEDIATE DELIVERY

Dravo Crane Cab Coolers are built in two models—the self-contained unit, mounted on any available space on the crane and the new split-type unit where the condenser section is mounted on the crane, with the conditioning section in the cab.

The Dravo Crane Cab Cooler can be easily and quickly installed on any type of crane with a minimum of down-time required. Units are available now! Write for more information —or phone the nearest Dravo Office and have our representative call on you.

DRAVO CORPORATION

602 Dravo Building, Fifth & Liberty Avenues, Pittsburgh 22, Pa.

ATLANTA • BOSTON • CHICAGO • CLEVELAND • DETROIT
NEW YORK • PHILADELPHIA • PITTSBURGH

John B. Hazle was named general works manager of Interlake Iron Corp., Cleveland, Ohio. Lindsey Johnson succeeds Mr. Hazle as general superintendent at Toledo, Ohio. **B. H. Carmichael** transfers to Toledo to become assistant general superintendent and blast furnace superintendent of that plant. **Burnett Minier** was promoted to assistant general superintendent and coke oven superintendent at Erie, Pa.

R. F. Nicholson has been appointed assistant superintendent, production planning department, Fairless works, U. S. Steel Co., Morrisville, Pa.

Roger S. Ahlbrandt has been elected treasurer of Allegheny Ludlum Steel Corp. and assumed his new duties on September 1. At the present time **Clark W. King,** executive vice president, serves also as treasurer.

W. Cordes Snyder, Jr., has been elected president and chief executive officer of Blaw-Knox Co. Mr. Snyder at one time was a vice president of the company

W. CORDES SNYDER, JR.

in charge of its Lewis Foundry & Machine division, and more recently has been vice president of Koppers Co., Inc., and manager of its metallurgical department. Mr. Snyder is expected to assume his duties with the Blaw-Knox Co. on or about November 1, 1951. **William P. Witherow**, formerly president and chairman of Blaw-Knox Co., will continue as chairman of the board. **Chester H. Lehman** will continue in his present capacities of vice chairman of the board and executive vice president.

Robert R. Longwell has been appointed Baltimore engineering and service manager for Westinghouse Electric Corp. to be located at Baltimore, Md.; and **George E. Grosser** has been appointed district consulting and application engineering supervisor, with headquarters at Philadelphia, Pa.

Hans A. Altorfer has been appointed chief engineer, Nordstrom Valve division of Rockwell Manufacturing Co., Oakland, Calif.

Charles Ebem Wilson, sales vice president of the Worthington Pump and Machinery Corp., Harrison, N. J., has been appointed a West Coast consultant on sales problems. Mr. Wilson will retire from his present position and activities in corporation affairs effective October 1, but will continue in a consulting capacity on sales problems at Worthington's offices in Los Angeles, San Francisco, Seattle and Salt Lake City.

Ohio Rolls

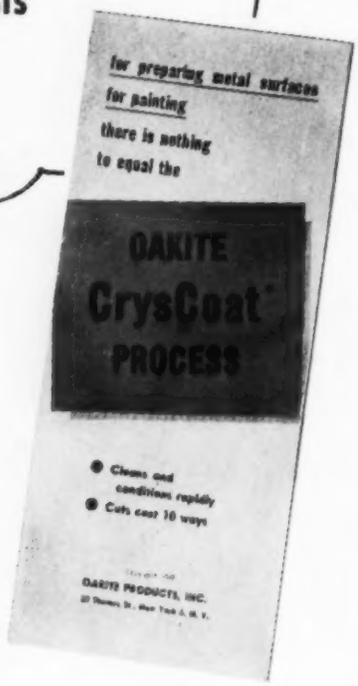
SHAPING METAL FOR ALL INDUSTRY

At Ohio Steel our system of INTEGRATED PROCESS CONTROL contacts every phase of manufacturing and testing. Engineers follow and chart performance records of every roll that leaves our plant. This data is collected into a roll history and preserved in Ohio Steel files along with manufacturing and testing records of the roll. Roll histories, production information, research findings and anything learned from rolls bought as scrap, provide PROCESS CONTROL with material for improving manufacture of Ohio Rolls.

THE OHIO STEEL FOUNDRY CO. LIMA, OHIO

PLANTS AT LIMA AND SPRINGFIELD, OHIO

Clean steel—
condition it for painting—
and cut costs
10 ways



This FREE Folder Tells How To Do It

WITH minimum equipment... in minimum time... at minimum cost... the OAKITE CrysCoat PROCESS*—cleans metal surfaces and prepares them for painting... prevents corrosion before and after the metal is painted. *Reg. U.S. Pat. Off.

By eliminating the need for separate cleaning and phosphating operations, the CrysCoat treatment cuts costs 10 important ways.

FREE Write to Oakite Products, Inc., 38H Thames St., New York 6, N. Y., for 8-page illustrated Folder F7642 describing the 19 advantages of the OAKITE CrysCoat PROCESS.

SPECIALIZED INDUSTRIAL CLEANING

OAKITE

MATERIALS • METHODS • SERVICE

Technical Service Representatives in Principal Cities of U. S. & Canada

Arthur N. Dugan, vice president of the National Bearing division of American Brake Shoe Co. has retired after 37 years service, but will continue his connection with the company as a consultant. **Pearce D. Smith,** sales representative for National Bearing division, has transferred from Pittsburgh to the company headquarters in New York, N. Y.

A. P. Wendland has been appointed manager of the general service department of the Elliott Co., with

A. P. WENDLAND

headquarters at Jeannette, Pa. Mr. Wendland succeeds the late **Frank Murphy** who had been Elliott service manager since the department was organized in 1918.

Raymond T. Joyce was named manager of operations for the Brooks Oil Co., Cleveland, Ohio. Mr. Joyce is secretary of the company and will continue to serve

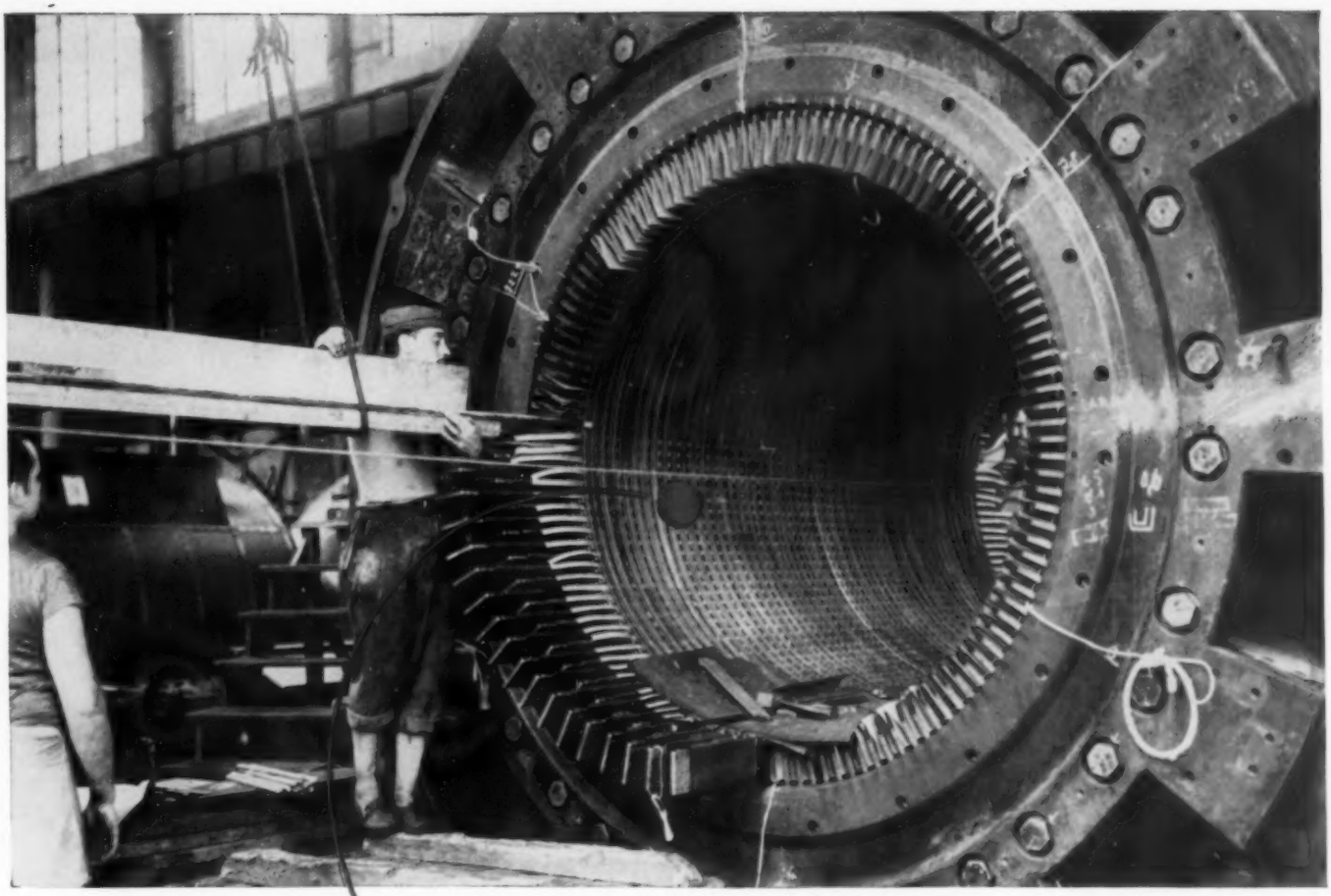
RAYMOND T. JOYCE

in that capacity. In addition to his duties as manager of operations and secretary, Mr. Joyce will serve as chairman of the plant planning committee and of the pension fund committee.

Frank H. Webster was appointed assistant manager-western division of Hyatt Bearing division, General Motors Corp., Chicago, Ill.

Gilbert I. Clark has been appointed project engineer of the American Cladmetals Co.

Dr. James F. Eversole was named manager of research administration of Union Carbide and Carbon Corp. Dr. Eversole will help co-ordinate the research



National gave this generator brand-new power

In the illustration at the top of the page the coil bars are being drawn into position. The lower illustration shows the coils being connected to the leads. This 3-phase, 50-cycle, 13,800-volt generator develops 45,000-kva at 1500-rpm.

Extra flexibility was needed in this rebuilding job. When the generator failed it was necessary to find someone who was equipped to handle the specialized repairs which were required. National was chosen. National engineers and technicians completely redesigned the stator windings; the National shops produced the bar design low-loss Roebel transposition type coils; and a National engineer was right there on the ground to supervise the actual rewinding of the generator. The result? A stator which gives more power at a lower operating temperature.

National can do the same for *your* motors or generators, whether they are special or not. Our experience and equipment are ready to work for you and to lower your power costs. Write or wire (or cable NATCOIL) *today*.

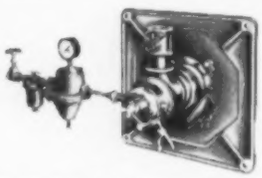
NATIONAL ELECTRIC COIL COMPANY

COLUMBUS 16, OHIO, U. S. A.

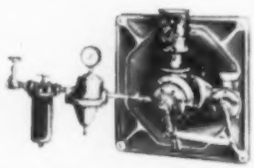
ELECTRICAL ENGINEERS: MAKERS OF ELECTRICAL COILS AND INSULATION—REDESIGNING AND REPAIRING OF ROTATING ELECTRICAL MACHINES

The Solution to Your Combustion Problems May Be Among These

HAUCK
OIL BURNERS



Proportioning Oil Burner with single lever, simultaneous control of oil and low pressure air—manual or automatic. Precise combustion quality over broad firing capacity range. Cat 410.



Combination Proportioning Oil and Gas Burner with equally good combustion of either fuel; switch fuels instantly without production loss. Cat. 408.

Series F Burner for individual hand control of oil and low pressure air with 10 to 1 turndown in firing capacity; only one air connection. Cat. 411.

High Pressure Steam or Air Atomizing Oil Burners; cylindrical, conical or flat flame producing types. Cat. 456.

With the enviable performance of thousands upon thousands of Hauck Burners on furnaces, kilns, lehrs, ovens, dryers, air heaters, boilers, etc., to prove their outstanding record of heating quality and fuel economy, it's time you investigated how they can help overcome your combustion problems and improve your heating processes.

Whether for converting old equipment or installing them on new equipment, your production is bound to improve with Hauck Oil Burners on the firing line.

Write for Catalogs on Any or All of These Burners

HAUCK MANUFACTURING CO.
Combustion Engineers • Manufacturers of Oil and Gas Burners and Equipment
114-124 Tenth Street • Brooklyn 15, N. Y.

activities of all of the corporation laboratories where basic research and development work is being done on alloys, chemicals, gases, carbons, and plastics.

William Croysdale, assistant to manager of the production department of the metal products division of Koppers Co., Inc., since last May, has been named manager of the Bartlett Hayward plant of the division in Baltimore, Md.

Owen R. Rice, metallurgical engineer with broad experience in blast furnace design and operation both in this country and abroad, was named vice president and manager of the Freyn Engineering Department, Engineering and Construction Division of Koppers Co., Inc.

Paul W. Arnold and **Richard A. Geuder,** two top engineers of Reliance Electric & Engineering Co., Cleveland, Ohio, were elevated to new responsibilities in the company's general sales organization. Mr. Arnold, who has served as manager of product sales for the past several years, moves up to the newly created post of

R. A. GEUDER

executive assistant to the sales vice president. Mr. Geuder, who since 1944, has headed the company's application engineering work, becomes manager of a new department of applied engineering and industry sales, the latter representing a consolidation of other specialized activities, including contract sales, federal and marine sales, and general industry applications.

Claude H. Groom, of Dowell, Inc., Tulsa, Okla., has been promoted to assistant sales development manager. Mr. Groom formerly was a development engineer in Dowell's industrial division.

C. W. Miller has been named manager of large power transformer engineering for the transformer division of the Westinghouse Electric Corp. at Sharon, Pa. He succeeds the late **W. G. James,** who died unexpectedly on August 10.

C. W. Schweers, director of sales in the general machinery division, Allis-Chalmers Manufacturing Co., Milwaukee, Wisc., was named vice president in charge of sales for the general machinery division. **J. F. Roberts,** director of engineering in the general machinery division, was named vice president in charge of engineering for the general machinery division, and **W. A. Yost,** manager of the mechanical power depart-

"There are Good Metallurgical and Design Reasons for the Low Exciting Current and Low Core Loss of the POLE STAR"

says Clarence J. Witsberger, *Electrical and Metallurgical Engineer*
PENNSYLVANIA TRANSFORMER COMPANY
Member ASTM Committee A6 on Magnetic Properties

Modern distribution transformers are fabricated of preferred oriented grades of cold reduced silicon steels. It is desirable therefore to take full advantage of the high permeability and low loss characteristics of this fine grade steel. This is accomplished in the Pole Star core design.

Laminations individually lapped in Pole Star core

Magnetic Circuit of Epstein Test. Laminations Individually Lapped

Low Reluctance at Lap Joint Results in Low Exciting Current

A minimum reluctance at the joint of the Pole Star Core is achieved by lapping the individual laminations. This is the same type of lap joint used in the magnetic circuit of the latest approved method for testing the permeability of preferred oriented cold reduced silicon steels. This test is known as the 25 cm. Epstein Test for core loss and permeability. The Pole Star core achieves a low exciting current by combining High Permeability Steel with a low reluctance joint.

Absence of Adhesions in Core Results in Low Core Loss

The core is carefully annealed in controlled-atmosphere furnaces, but does not suffer the disadvantages of adhesions. That is because in the core assembly process—when the core is built into the coils—the laminations are separated from each other. The absence of adhesions between laminations and the presence of high interlamination resistance keeps the core loss at a low value.

Pennsylvania TRANSFORMERS

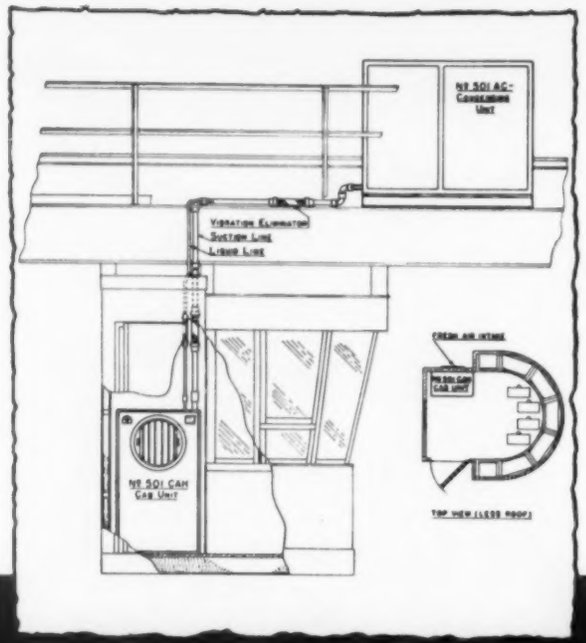
POLE STAR

Pennsylvania

TRANSFORMER COMPANY

CANONSBURG, PENNSYLVANIA

Greater Pittsburgh District



The Original Split System Cab Conditioner

This is the original split system now in use for over four years. Its operating efficiency has been unequalled. Throughout this period the Lintern split system has demonstrated its greater cooling efficiency, lower maintenance, and trouble-free operation. All of the many installations throughout the country have given universal satisfaction.

In the Lintern split system Aire-Rectifier the condenser is located at any convenient place on crane, and evaporator (cooling coil) is placed in cab. The two units are connected with refrigerant lines properly secured and protected against breakage. Condensers are air-cooled, assuring trouble-free service with but little maintenance.

Requiring but little space, the condenser and cab units are easy to locate, respectively on crane and in cab so that they do not interfere with operations in any way.

These Aire-Rectifiers hold properly insulated cabs at a cool 85° F. and relative humidity of 30% to 50% at ambient temperatures of 170° without excessive head pressures or wear on the machine.

May we send you complete information on the Lintern split system Aire-Rectifier (patents pending) and its application to your particular needs?

THE LINTERN CORPORATION

29-2 RIVERSIDE DRIVE • BEREA, OHIO

ment, was named a vice president of the general machinery division. **G. F. Langenohl,** assistant treasurer, was elected to the position of treasurer and appointed assistant secretary. **N. D. Johnson,** assistant secretary, will continue to serve in that capacity and assume additional responsibilities as assistant treasurer. Two new assistant comptrollers were also named. They are **E. J. Dietrich,** assistant to the comptroller, and **T. D. Lyons,** works comptroller.

M. B. Atkinson was named manager of the Detroit, Mich., office of Wagner Electric Corp. succeeding **R. L. Wells** who retired June 30, under the company's pension plan, after 40 years service. Mr. Atkinson, a graduate electrical engineer from the University of Missouri, has been a salesman in the Detroit office for 23 years with the exception of 3½ years service in the Navy during World War II.

A. B. Fisher, Jr., chief engineer for the Engineering and Construction division of Koppers Co., Inc., since

A. B. FISHER, JR.

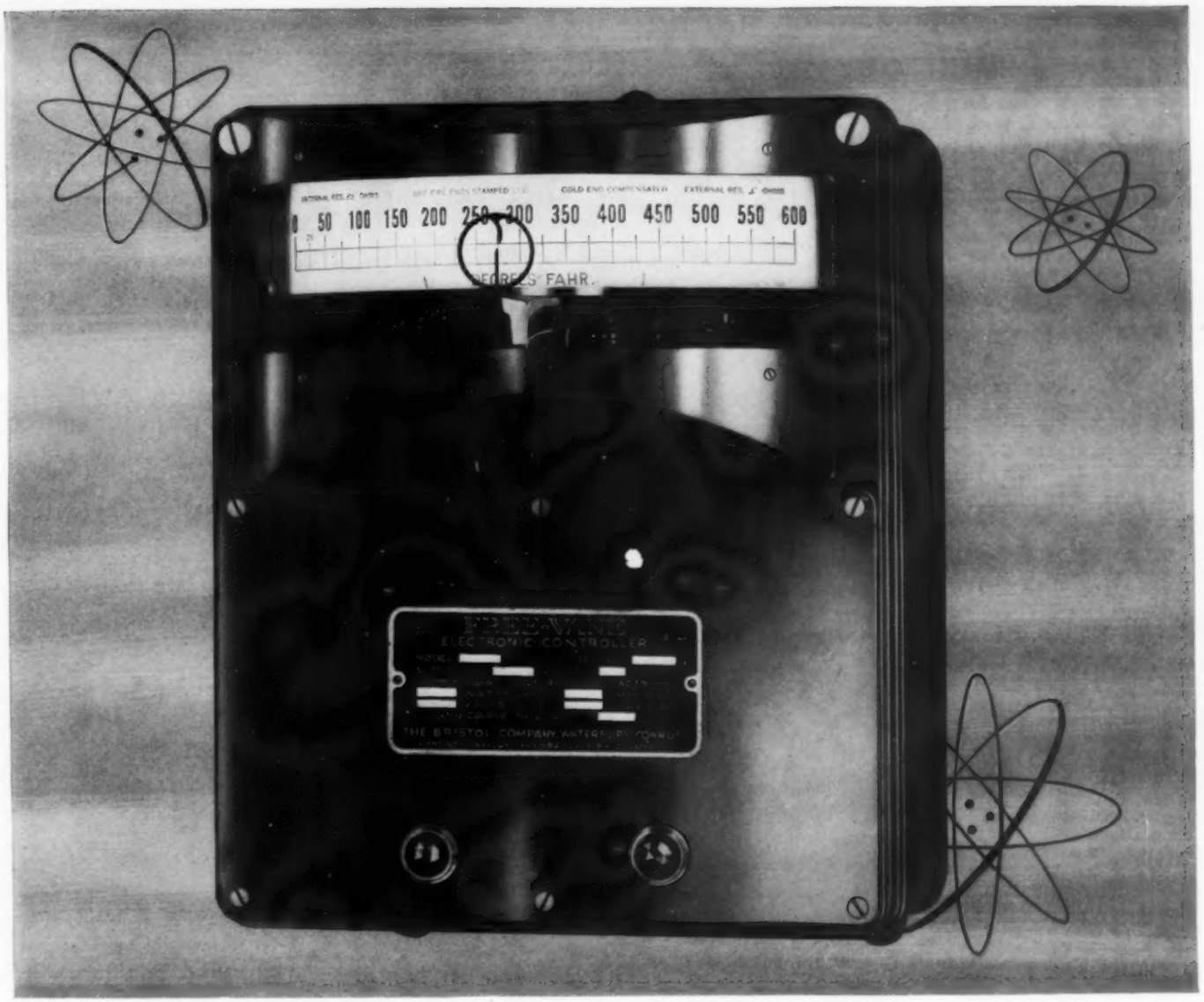
1949, has been named operating manager of Koppers' Freyn Engineering Department offices in Chicago, Ill. Mr. Fisher will succeed **Gordon Fox,** vice president and operating manager of the Freyn department, who is retiring from this position January 2, 1952, but will continue in a consulting capacity with Koppers Co., Inc. **R. J. Sprott** will succeed Mr. Fisher as chief engineer; **C. S. Carden** will succeed Mr. Sprott as assistant chief engineer; and **A. D. Orefice** will succeed Mr. Carden as manager of the division's by-product section.

Warden F. Wilson was elected president and general manager of Donegal Manufacturing Corp., Marietta, Pa. Mr. Wilson was formerly general sales manager of Lebanon Steel Foundry, Lebanon, Pa.

Wilbur E. Lunger has been elected a vice president of the American Car and Foundry Co., New York, N. Y. Mr. Lunger was formerly assistant vice president in the production department.

Obituaries

William Gordon James, 61, manager of large power transformer engineering for the transformer division of the Westinghouse Electric Corp. at Sharon, Pa., died unexpectedly on August 10 of a heart condition.



EVEN HEAT TREATING

with electronic control

Set the control point at the desired temperature . . . and let the instrument do the rest.

That's what happens in plants which use Bristol's Free-Vane Electronic Pyrometer Controllers for automatic control of furnaces, ovens and salt pots.

Thousands of these controllers are in use giving outstanding performance.

An extremely simple instrument—no moving parts in the control circuit. It is offered for low-high and proportional current-input control for use with thermocouples or radiation units. Temperatures up to 4000 F.

BRISTOL

Write for Bulletin PB1237. Address THE BRISTOL COMPANY, 123 Bristol Road, Waterbury 20, Conn. (The Bristol Company of Canada, Ltd., Toronto, Ont.)

The dependable Guidepost of Industry

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

John F. Pelly, lubrication engineer, Bethlehem Steel Co., Bethlehem, Pa. died recently.

Victor A. Menaglia, 57, Pittsburgh district manager, SKF Industries, Inc., died September 10. Mr. Menaglia was born in Black Diamond, Wash. He received his education at Washington State College where he was graduated as a mining engineer in 1915.

VICTOR A. MENAGLIA

He started his business career as a mining engineer with Carbon Hill Coal Co., Carbonado, Wash., and in 1916 went to the Belgian Congo as a mining engineer with Societie Forestiere et Miniere du Congo. In 1920, he returned to the U. S. to take a position as superintendent for Kennecott Copper Corp. From 1922 to 1930 he was with Roslyn Fuel Co., Roslyn, Wash. as a mining engineer. He became district manager of the Pittsburgh office of SKF in April 1930, which position he held until his death.

Frank V. Carroll, 63, for many years chief engineer at the Indiana Harbor works of Inland Steel Co., Chicago, Ill., and for the last three years consulting engineer for the company, died recently.

James W. Haygood, 56, process service engineer for Linde Air Products Co., Pittsburgh, Pa., for 30 years, died September 11.

Corrosion Proof Construction Materials

CEMENTS FLOORS LININGS COATINGS

Rely on Atlas' years of experience and recognized leadership to help solve your problems. Write 65 Walnut Street, Mertztown, Pa.

Over a half century of service

Atlas

MINERAL PRODUCTS COMPANY

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ELECTRIC MELTING FURNACE

. . . as ever, the dependable furnace for the production of high-grade stainless, alloy and rimming steels.

Removable roof of new design now available for the larger furnaces.

AMERICAN BRIDGE COMPANY

General Offices: Frick Building, Pittsburgh, Pa.

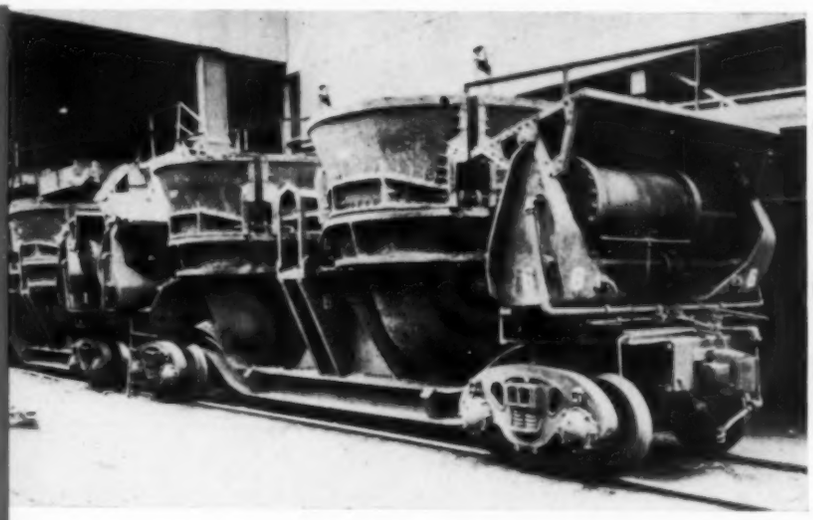
Contracting Offices in New York, Philadelphia, Chicago, San Francisco and other principal cities
United States Steel Export Company, New York

USS AMERICAN BRIDGE

UNITED STATES STEEL

TREADWELL

CINDER CARS



for

BLAST FURNACE

OPEN HEARTH and

ELECTRIC FURNACE SERVICE

SINGLE,

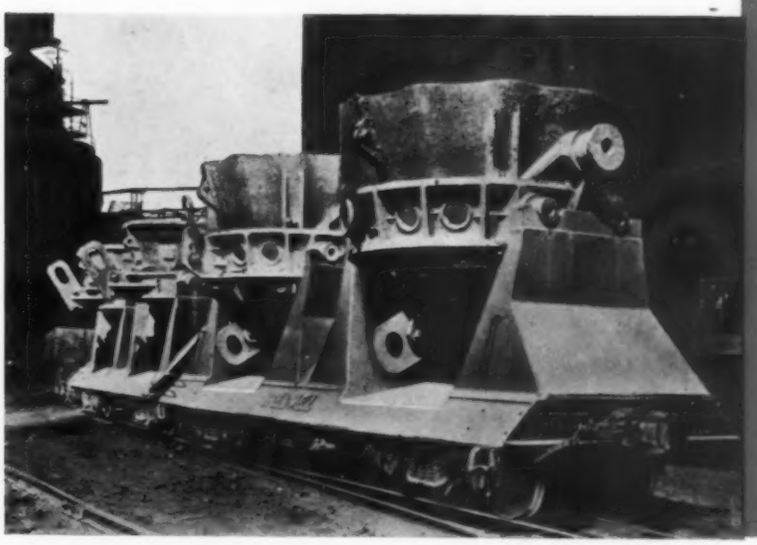
TWIN and

MULTIPLE POT DESIGN

Operated by

AIR, STEAM,

MOTOR or CRANE



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CEntral 6-6704

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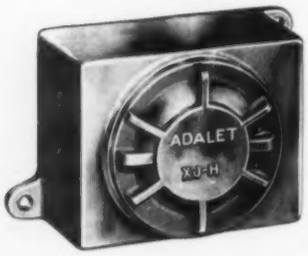
PITTSBURGH 22, PA.
ATlantic 1-2883

HEAD, WRIGHTSON AND CO., LTD., Thornaby on Tees England

Explosion - Proof Aluminum Alloy Boxes



Overall Dimensions
9" x 8" x 6½"

Easy to Install Because Light Weight

Best Because Strong, Rustless

For use as junction or splice boxes in the conduit system, or as enclosures for standard relays and controls when used in hazardous locations. Uniform ½" wall can be drilled and tapped for conduit up to 3". Send for bulletin F-9-51 describing other Adalet explosion-proof fittings.

Stock shipments
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CRANE BUILDERS Since 1903

BEDFORD CRANES

Capacities 5 to 150 Tons

Designed and Engineered to Meet Your Requirements

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ELECTRIC OVERHEAD TRAVELING CRANES
GANTRY CRANES • STEEL DERRICKS
BUILT TO YOUR SPECIFICATIONS
STRUCTURAL STEEL • STEEL BUILDINGS

BEDFORD FOUNDRY & MACHINE CO.

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BEDFORD, INDIANA
U. S. A.

Gray Iron Castings

Cobbles don't destroy this

X-RAY THICKNESS GAGE

AT WEIRTON STEEL . . .

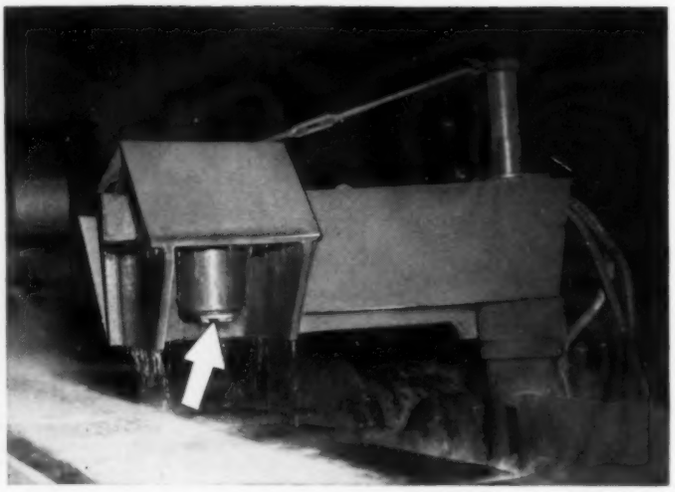
. . . hot strip races beneath the top detector of a G-E X-Ray Thickness Gage at speeds exceeding 1700 fpm. Mill operators claim it has enabled them to reach gage on the first slab, where formerly four slabs would go through the mill before a report could be obtained.

This unit has given excellent service since its installation in March 1949.

Now mill operators can:

- Reach gage on the first slab
- Cut down on re-rolls
- Boost on-gage tonnage

Ask your G-E representative for more information about the X-Ray Thickness Gage, or write Sect. 687-80, General Electric Company, Schenectady, N. Y.

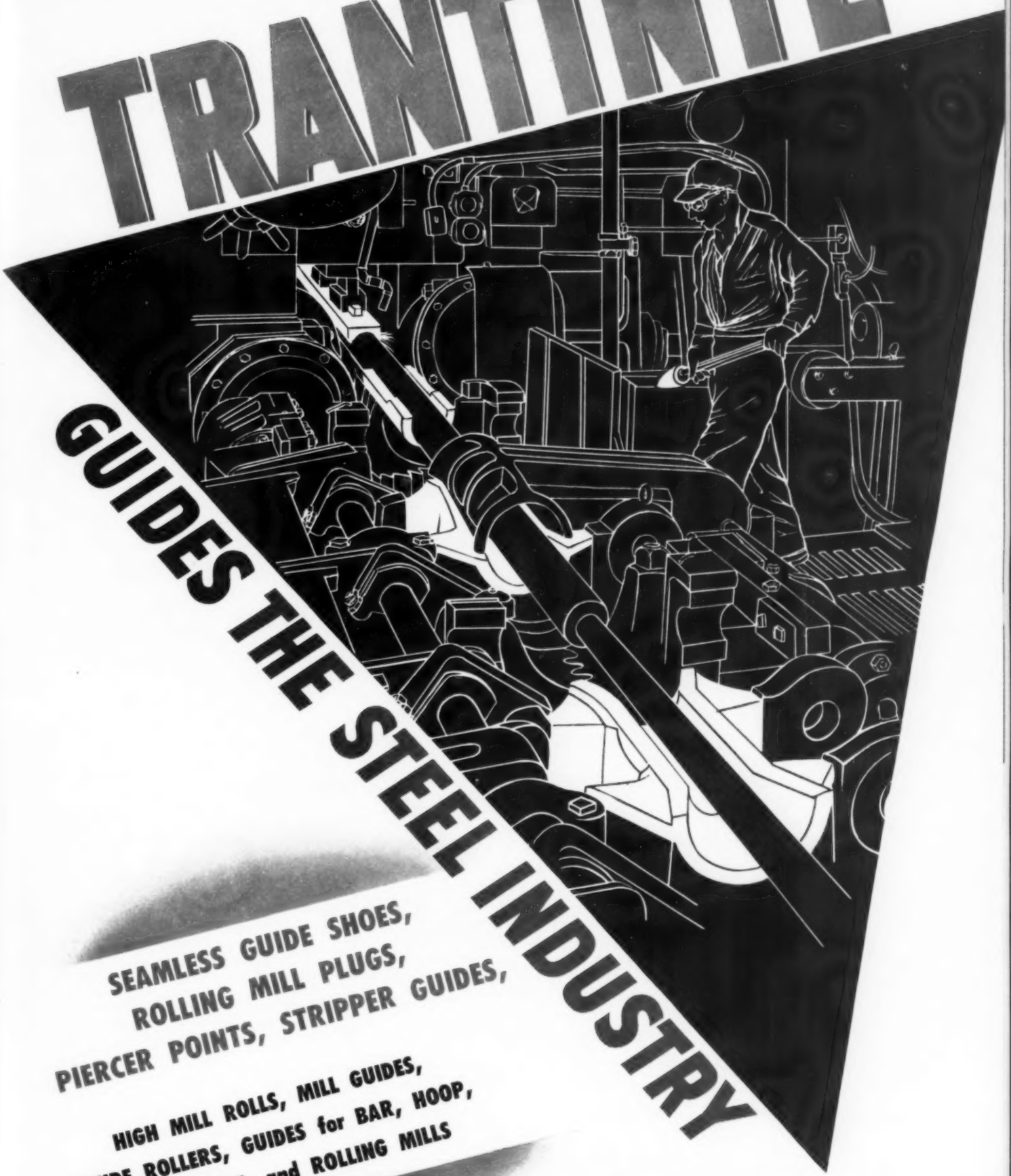


Top detector of G-E 100-kv X-Ray Thickness Gage (arrow), shown mounted on 66" hot-strip mill at Weirton, W. Va.

GENERAL ELECTRIC

687-80

TRANTINYL



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SEAMLESS GUIDE SHOES,
ROLLING MILL PLUGS,
PIERCER POINTS, STRIPPER GUIDES,

HIGH MILL ROLLS, MILL GUIDES,
GUIDE ROLLERS, GUIDES for BAR, HOOP,
STRIP, SHAPE, and ROLLING MILLS

Youngstown Alloy Casting Corp.
Youngstown, Ohio

AX-5 and 401

5 standardized NATIONAL brushes for mill-type motors!

Utilizing 2 proven grades — AX-5 and 401

For heavy-duty, mill-type motors, you can't get better brushes than NATIONAL CARBON's STANDARDIZED brushes using grades AX-5 and 401. They handle heavy loads with ease and sturdily withstand the effects of vibration. They keep the commutator in fine shape, even after long service. And more, *only two brush grades are used for the five* STANDARDIZED *brushes.*

RESULT? Lower maintenance costs all along the line! Armature removal for commutator maintenance greatly reduced. And, don't forget, these brushes are STANDARDIZED. You can get 1 box or 10,000 boxes for the same low, flat price per brush. For convenience, order by NC number.

STANDARDIZED BRUSHES FOR MILL-TYPE MOTORS

NC Number	A.I.S.E. Std. No.	Specifications		Applications
20-4800	21	2¼ x 1½ x ⅝	AX-5	MC 8-12-21-81-121 MD 104-406-408-412-416-418 W 610 K 4-KG4
20-5600	25	2¼ x 1¾ x ⅝	AX-5	MC 50-608 MD 410 K5-KG5
24-4800	29	2½ x 1½ x ¾	AX-5	MC 12-60-101-121-612-614 MD 418 MT 00-0
24-5600	30	2¼ x 1¾ x ¾ "Plytek" (⅜-⅜)	AX-5	MD 414-612-616
24-6400	32	2½ x 2 x ¾	401	MC 14-16-18-70-80-90-100 103-141-161-181-610 MD 420-421-422 SW 75-EW-FW-14W75- 18W150-K6-KG6

Order by NC Number

FOR COMPLETE INFORMATION
on NATIONAL CARBON's brush standardization program and the advantages it offers, write to National Carbon Company, A Division of Union Carbide and Carbon Corporation, Dept. IS.

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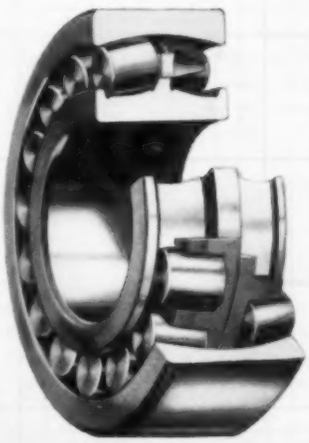
250,000 pound lift on Torrington Bearings

Overhead cranes built by The Cleveland Crane & Engineering Co., are equipped with Torrington Spherical Roller Bearings for smooth, dependable heavy-duty service.

These self-aligning bearings compensate for shaft deflections caused by shock loads—thus binding stresses cannot develop. Carefully selected materials and up-to-the-minute production methods assure long bearing life with minimum maintenance.

Our engineers will gladly help you put Torrington Spherical Roller Bearings to work in *your* heavy-duty equipment.



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South Bend 21, Ind. • Torrington, Conn.
District Offices and Distributors in Principal Cities of United States and Canada

SPHERICAL ROLLER
TAPERED ROLLER
STRAIGHT ROLLER
NEEDLE
BALL
NEEDLE ROLLERS

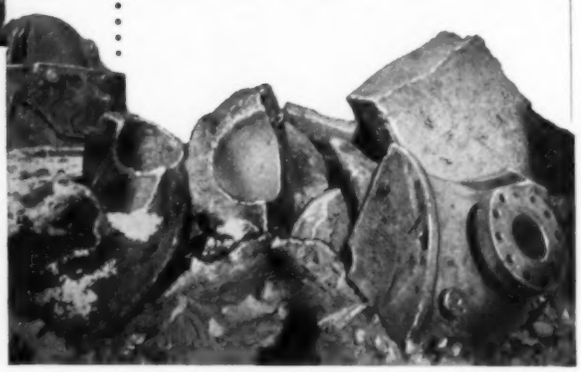
TORRINGTON *SPHERICAL ROLLER* **BEARINGS**

Heavy Scrap Cutting jumped from 150 to 500 tons per month . . .

WITH COSTS CUT TO THE BONE

1 An AIRCO NO. 41 RADIAGRAPH cuts a button to charging box size in fifteen minutes.

2 Finished cut, showing steel and cast iron sections cut to charging box size.



A large eastern steel mill was cutting only 150 tons of heavy scrap per month with the torch and lance method of reduction . . . and not all of it could be cut to charging box size. Therefore, it was necessary to wait until the open-hearth furnaces were rebuilt to charge the oversize pieces—a costly and time-consuming process.

Airco Technical Representatives, with long experience in the machine cutting field, suggested a way to expedite heavy scrap cutting, and bring it up to present demand. An Airco No. 41 Radiagraph gas cutting machine, fitted with an Airco Style 6740 torch and Style 174 cutting tip, was installed. Now the mill averages 500 tons of heavy scrap per month—*all of it cut to charging box size.* This tremendous production rate has resulted in major savings for the mill . . . savings of time, trouble and money.

You, too, may be able to utilize Airco's Technical Sales Service to help you cut costs . . . speed production. Their extremely broad knowledge may help solve your metal-working problem. Write your local Airco office for complete information.

AIRCO

AIR REDUCTION

AIR REDUCTION SALES COMPANY • AIR REDUCTION MAGNOLIA COMPANY
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REPRESENTED INTERNATIONALLY BY AIRCO COMPANY INTERNATIONAL
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Dealers and Offices in Principal Cities

FOR *Increased Tonnage*

FOR *Finer Finishes*

FOR *Longer Life*

SPECIFY ✓

BIRDSBORO ROLLS

Copper Bearing

ALLOY STEEL and ALLOY IRON

√ For all types of MATERIALS

√ For all types of SHAPES

√ For all types of FINISHES

BIRDSBORO Rolls are individually designed and engineered in accordance with the analyses and physical properties that will best accomplish *your specific* rolling requirements.

BIRDSBORO offers you the experience of over a half a century of service to the metal producing industry of America. If you are looking for increased tonnages, finer finishes and longer roll life, put your roll problems in the competent hands of BIRDSBORO engineers.

BIRDSBORO

STEEL FOUNDRY & MACHINE CO.

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Offices in:
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ROLLS

Designers and Builders of:
Rolls • Crushing Machinery • Steel Mill Machinery
Hydraulic Presses • Special Machinery • Steel Castings

R-6-51

10-TON, 29′-1½″ SPAN
O. H. FLOOR CHARGER

BUILT BY *MORGAN Engineering*

DESIGNERS • MANUFACTURERS • CONTRACTORS

BLOOMING MILLS • PLATE MILLS • STRUCTURAL MILLS

ELECTRIC TRAVELING CRANES • CHARGING MACHINES

INGOT STRIPPING MACHINES • SOAKING PIT CRANES

ELECTRIC WELDED FABRICATION • LADLE CRANES

STEAM HAMMERS • STEAM HYDRAULIC FORGING PRESSES

SPECIAL MACHINERY FOR STEEL MILLS

THE MORGAN ENGINEERING CO.

ALLIANCE, OHIO PITTSBURGH—1420 OLIVER BUILDING

Illustrated is a Morgan 10-Ton High Visibility Floor Charger with hydraulic hoist and box clamp.

By using a hydraulic hoist, the large hoist motor with its reduction unit usually used, is eliminated, thus providing maximum visibility for the operator.

A hydraulically operated head at end of peel clamps the box head so the box will not "flop around" when turned.

Four (4) take-up reels for handling the motor leads are provided, thus eliminating twenty (20) conductor angles on the bridge.

Trolley is carried on four (4) top running wheels with two (2) kick-up wheels. The two rear upper and kick-up wheels are spring suspended for absorbing shocks when picking up loaded boxes.

Equipment News...

TOURING EXHIBIT

▲ Completely refitted and overhauled, Square D's two display coaches, the "Milwaukian" and "Detroiter," are about to begin their second national tour. The two vehicles recently completed a 50,000 mile trip extending over fourteen months. A repeat visit to 37 Eastern states is scheduled to start in September.

The two display coaches were originally conceived as a method of taking Square D's complete line of electrical distribution and control equipment to their customers. Results were even more favorable than anticipated. By traveling back roads to isolated sections and covering all metropolitan marketing areas, more than 45,000 people were personally conducted through these electrical equipment exhibits. All types of customers were invited to see the display coaches including architects, engineers, contractors, utilities, distributors and industrial accounts.

An interesting feature of the display coach program is the method of selecting drivers for the vehicles. Square D student engineers are assigned this responsibility. These men, recruited from leading technical schools throughout the country, enter a formal training program designed to groom them for field engineering assignments with Square D. A definite period on the display coach during their training period is proving invaluable in thoroughly acquainting them with the Square D line and preparing them for subsequent customer contact work.

View shows inside of one of the two display coaches.

GAS PRODUCING PLANT

A revolutionary, low-cost gas producing plant, so versatile that it can make city gas ranging in heat content from 300 Btu to 1050 (the equivalent of natural gas), has gone into production at the East Plant of Rochester Gas & Electric Corp., Rochester, N. Y.

The new plant, built as a demonstration unit, is designed to produce more than one million cubic feet of city gas per day and can use gasoline, propane, butane, light oil or natural gas as raw materials. Known as the Koppers-Hasche process, the plant was built by the Engineering and Construction Division of Koppers Co., Inc., which has world patent rights for this type of installation granted by Dr. R. Leonard Hasche, the noted chemical engineer who invented it.

J. Hawley Taussig, Jr., manager of the gas department of Koppers, said that the Koppers-Hasche process, which is based on either thermal or catalytic reforming, gives the nation's gas industry the first low-cost unit for either the reforming of natural gas or the making of a gas which can augment natural gas at periods of peak demand.

"With present high costs, it frequently is impractical for utilities to deliver straight natural gas to customers even when it is available in their areas, because millions of dollars would be required in many cases to convert meters and fixtures in homes to the use of such gas." Mr. Taussig said. "With this process, it appears that natural gas may be reformed in such a manner that it can be delivered to homes with a Btu content comparable with past practice, yet costs may be reduced because the process produces substantially more of the lower Btu gas.

"But in areas where straight natural gas now is used, this process provides a means of making gas of comparable Btu content during periods of peak demand or when a break in the line cuts off supply," Mr. Taussig continued. "This is because the process can deliver gas of the same characteristics and heat content that will mix readily with natural gas and burn satisfactorily in fixtures adjusted for natural gas use."

While the Koppers installation, built in cooperation with Rochester Gas & Electric, is aimed at solving some of the burdensome problems in production of a usable city gas, the Koppers-Hasche process is being given avid attention by the chemical industries, Mr. Taussig said.

This is because with only minor changes in raw materials or production procedures, the process can be made to synthetically produce benzene, ethylene, and acetylene—all chemicals now greatly in demand in the plastics and other industries. For instance, benzene and ethylene are major ingredients of polystyrene, the most-used plastic, while acetylene may be extensively used in making the new synthetic fibre, Orlon.

Present patent rights assigned to Koppers cover engineering and construction of the Koppers-Hasche plants for use by gas utilities, and Koppers is presently negotiating for rights to build the plants for production of benzene, ethylene, acetylene and other chemical production.

In the Hasche process, the various chemicals are produced chiefly by varying the operating temperature, thereby setting up certain chemical reactions which change the molecular structure of the raw materials used.

The Koppers-Hasche process is particularly appealing to the gas and chemical industries because of its simplicity and subsequent low cost, Mr. Taussig said. Although the Rochester installation just completed is only a demonstration plant, it is estimated that a full-scale plant, capable of producing sufficient gas for the entire city, could be constructed at far less cost than any other process.

Heart of the Koppers-Hasche process is a thermal reforming furnace

which may operate at varying degrees of temperature up to, and even above 2200 degrees Fahrenheit. For producing city gas, it is operated in the 1500-1600 degree range.

In the Rochester installation as it is presently being used, natural gas comes in from a large main, pressure is reduced to 5 pounds per square inch, it is metered, and then flows through a valve which regulates its rate of flow. From here, it goes to a mixing chamber where it is combined with air in a normal proportion of 1 to 1. This mixture enters the furnace for treatment.

Inside the Koppers-Hasche furnace is a core of checker tile 9 in. wide and 20 in. high, divided in the center by a reaction chamber in which a catalyst may or may not be used, depending on the type of gas to be produced. Surrounding this core is 4½ in. of high-duty refractory brick, a like thickness of insulating brick and a steel shell, one-half inch thick . The gas and air mixture flows for one minute into one end of the 20-foot long furnace, then for one minute at the other end.

As the gas passes over the heated brick, the chemical change takes place and outlet pipes lead the reformed gas to a cooling tower and ultimately to gas storage holders. Pressure generated in the process eliminates the need for exhausters. Careful control of the process is had at all times through a special control panel which records temperatures, rates of flow, pressures and analyzes the gas mixture. Once in operation, the unit needs only periodic checking by one operator.

The Rochester unit occupies a space only 42 by 21 ft and except for the cooling tower, is less than 10 ft high. Mr. Taussig said that this unit could have been condensed into even smaller space had it been necessary, without sacrificing the ease of its operation.

PACKAGING PAPER

Development of a new heavy-duty packaging paper, treated with a volatile type rust inhibitor was announced by the Nox-Rust Chemical Corp. The new product was developed for protection of heavy machinery and bulky metal parts during storage and shipping. It is made for Nox-Rust by Glas-Kraft, Inc.

The paper called vapor wrapper, is tough, resilient, and tear-resistant. It is made of two high-strength kraft sheets, cemented together, and reinforced with spun glass fibers.

Identified as Nox-Rust No. 120 Glas-Kraft grade, it is one of a series of papers the company produces. The inner ply of kraft paper is impregnated with Callex, a volatile rust-inhibitor chemical. When a metal product is wrapped or shrouded with the wrapper, a vapor is released which prevents rust from forming. This product is also moisture and water repellent.

COPYING MACHINE

Charles Bruning Co., Inc., has developed new "BW Copyflex," designed especially for business and industrial offices and presenting features found in no other copying machine. It is mobile and requires no installation except connection to a standard 60 cycle, 110 volt a-c electric line.

The new model makes low-cost direct positive copies up to 11½ in. wide at speeds of from 1 to 22 fpm. An exclusive stepless, variable speed transmission guarantees instantaneous, accurate speed setting, and quiet vibrationless action. Another exclusive feature is the built-in, two-roll developer for film masters. The unit weighs only 488 lb, 29½ in. wide, 50 in. high and 28 in. deep. It is powered by a ⅙ hp motor and the light source is a special 940 watt mercury arc lamp.

EMULSION CLEANER

DuBois Co. announces its new, ready-to-use emulsion cleaner, "Super-Mul." The new cleaner is a high strength, active solvent emulsion cleaner specifically designed for the removal of industrial soils in spray washing machines. It cleans thoroughly, rinses freely, resists hard water, does not sludge out even with heavy soil loads.

The cleaner is not only effective, but it is also safe, both on personnel and materials. It does not attack metals and painted surfaces and will not deteriorate machinery or equipment. It is free of objectionable odor, is non-toxic and has a high flash point.

It is highly recommended for metal cleaning in one-stage washers, for cleaning prior to bonderizing, cleaning during processing and before painting. When used in low concentrations in the rinse, the cleaner provides interim rust-inhibiting. Also useful for pre-cleaning prior to alkaline cleaning and for wipe-down cleaning of equipment and machinery.

NEW GEAR PROCESS

The development of a new gear-manufacturing process employing carborization, which limits distortion to one one-thousandth of an inch per foot of diameter, was announced recently by Brad Foote Gear Works, Inc. Carborization is a means of imparting hardness to gears through the application of heat.

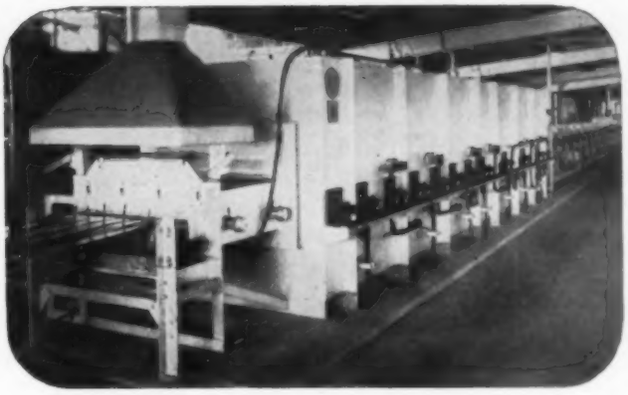
Although carborization has long been recognized as a hardening method in the manufacture of gears, the new process is unique in that the heat treatment is controlled to an unprecedented extent. The accuracy of the heat regulation accounts for the fine tolerances achieved. It was pointed out that with the new process there are now some twenty-inch gears in production which distort less than .0015 of an in., while the distortion of identical gears manufactured by the old method varies from .015 to as much as .045 of an in.

Brad Foote's refinement of carborization, the result of years of extensive research hardens the meshing surfaces of the teeth in gears to a high degree while leaving the cores of the teeth soft but tough. The result is that a certain flexibility is realized, the advantage being that the impact on the teeth is reduced through absorption of some of the shock by the soft cores, he said. Accordingly the specially treated gears are longer wearing while the efficiency of machinery containing them in substantially improved.

BURNER WALL

The design of a burner port is an important function in promoting good combustion and directing the flame to prevent impingement on the steel or on the refractory roof and

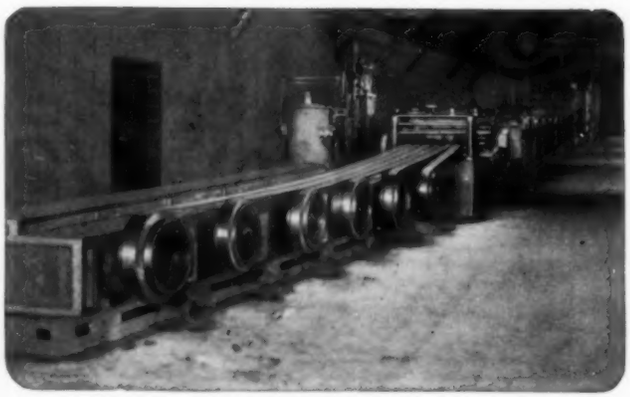
Steel strip in single or multiple strands up to a total width of 54" may be bright annealed or normalized, continuously, in this EF gas fired radiant tube installation. Capacity 7200 lbs. per hour.



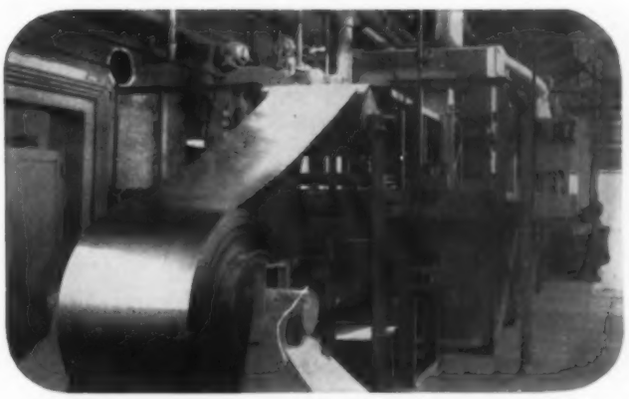
An EF electrically heated special atmosphere installation bright annealing six parallel strands of cold rolled steel strip, continuously. Handles single or multiple strands up to a total width of 30"

CONTINUOUS EF INSTALLATIONS

For Bright Annealing, Normalizing, Galvanizing and Other Continuous Processing of Strip



Another EF gas fired radiant tube, continuous furnace for bright annealing or normalizing cold rolled strip steel. Has preheater or burn-off chamber and handles 2000 lbs. strip per hour.



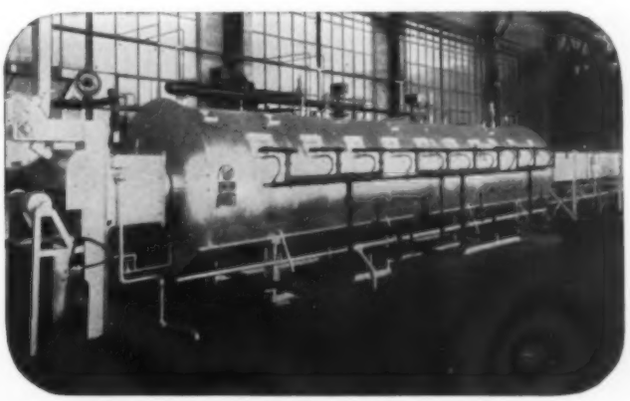
An EF special atmosphere furnace with flame preheating burn-off or oxidizing section, and controlled heating and cooling zones for producing various surface conditions on strip steel.

Designed and Built by

The Electric Furnace Co., Salem, Ohio

Gas Fired, Oil Fired and Electric Furnaces—For Any Process, Product or Production

This EF combination fuel fired and electrically heated strip processing unit provides extreme flexibility in heating, soaking and controlled cooling cycles for treating various grades of strip.



Stainless steel strip is bright or process annealed continuously in this EF gas fired special atmosphere tube muffle type furnace. It also handles other strip requiring lower temperatures.

sidewalls. The retention of the proper burner port contour during a period of service is of major importance. Therefore in selecting a refractory material consideration should be given to a material possessing a combination of extremely good spall resistance and high refractoriness. One installation of a Ramtite burner wall has been in almost constant use for the past 3 years, tripling the life of the previous refractory and still maintaining almost perfect burner port contour.

OPEN GEAR LUBRICATION

A 90 per cent savings in the lubricant used on open gears was revealed recently at one of the country's leading steel mills.

A fluid type gear lubricant—Texaco's Crater 2X Fluid—provided the savings and at the same time permitted increased operating efficiency.

The lubricant is applied with a spray gun. Less lubricant is needed per application and fewer applications are demanded as compared with manual servicing and the use of ordinary lubricating compounds.

Experience has shown that with a gallon of this fluid an operator can lubricate all the open gears in his department without having to refill the container.

TRAVELING HEAD GRINDER

Totally new conception and approach to the problems of face grinding is offered in the Mercury series E-20 traveling head grinder, as designed, developed and built by Mercury Engineering Corp.

Designed for the grinding of armor plate, it offers new opportunities in grinding edges, angular surfaces, compounds and bevels, as well as machining pads on heavy castings 20 ft. or longer.

Because of the unique factors, the new design eliminates completely the expensive and hard-to-maintain traverse bed common to conventional traveling head grinders. Both initial and maintenance cost are reduced to a new low.

This revolutionary grinder runs on self-powered precision rollers along rails machined to precision tolerances and equipped with built-in leveling devices. The unit, employing a 20 in. face-type grinding wheel mounted on a head which tilts from horizontal to full vertical, has complete mobility with traverse rate continuously variable. Two or more grinders can operate simultaneously on a single set of rails. These rails being mounted on a simple concrete base are kept clean by means of an efficient wiper system.

Super powered for continuous production, the 20 hp motor and heavy duty precision spindle assembly are mounted within rigid trunnions and arranged to feed in and out through 7 in. range, utilizing planetary gear driven motor reducer in combination with precision lead screw. Various increments of feed are accomplished electrically.

Mercury Engineering Corp., designers and builders of precision machinery for the past sixteen years, announces that in addition to the new grinder a full range of heavy duty grinders are now in construction, powered up to 40 hp with geared head drive and employing 30 in. grinding wheels.

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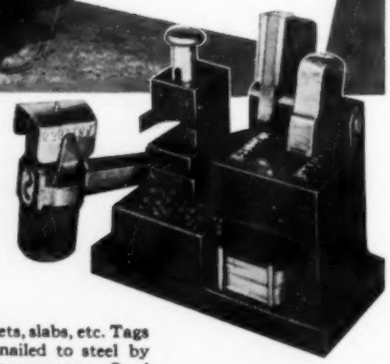
NAIL IDENTIFICATION TAGS TO STEEL!

—with the
"SAFETY" TAG EMBOSSING and TAGGING OUTFIT



It's hard to believe, but it's true—this Outfit enables you to quickly nail metal identification tags to hot or cold steel ingots, billets, slabs, etc. Tags are embossed, pierced and nailed to steel by swinging hammer in the ordinary manner. Send for complete data today on this remarkable unit.

Write for Bulletin J-547

M.E. CUNNINGHAM CO.
SAFETY STEEL STAMPS

105 East Carson Street • Pittsburgh 19, Pa.

EXHIBIT TOUR ENDS

The world's largest traveling showcase of electric products — General Electric Co.'s now famous "More Power to American Special" exhibit train—has reached the end of a 28,000-mile road.

Workmen at the company's Schenectady, N. Y., works are now completing the six-week task of dismantling the silver, 10-car streamliner and its 2001 exhibits of industrial products and techniques for the production and application of electric power.

The much-traveled symbol of American enterprise spent 14 months on a tour of the nation's industrial firing line. During the tour, the train was exhibited in 166 cities from coast to coast and played host to a select audience of nearly 200,000 industrialists and business and civic leaders.

The tour, aimed at bringing the latest G-E tips, techniques and products to a defense-busy production front, was a "complete and outstanding success," according to J. Stanford Smith, manager of advertising and sales promotion for the firm's apparatus marketing division.

Clayton P. Fisher, Jr., manager of the G-E apparatus exhibit train division, listed the train's most dramatic accomplishments as (1) its universal acclaim by press and public as a symbol of free enterprise and the American way of life; (2) its assistance to the nation's industries in their huge task of converting to defense production while maintaining a record output of peacetime wares, and (3) its role in giving impetus to the greater utilization of electric power in industry.

Public and customer reaction to the exhibit train far exceeded General Electric's most optimistic hopes, said Fisher. "Our files are crammed with congratulatory messages and with newspaper and magazine articles and editorials lauding the promotion and the spirit that prompted it."

The exhibit train was equally successful from a purely-business viewpoint, Smith added. The tour, he said, resulted in universally favorable reaction by old, new and potential customers; in greatly strengthened ties between G-E and the nation's electric power producers; in new prestige for the company and its district representatives, and in customer "contacts" that otherwise could not have been made with double the firm's present sales force.

General Electric also benefited internally as a direct result of the train tour Smith emphasized. The giant "sample case" served as a traveling classroom for G-E employees, and also played an important role in recruiting young engineers under the G-E banner, he explained.

While complimenting the work done by Fisher and personnel who produced and operated the train, Smith emphasized that much of the project's success was due to the efficiency and cooperation of the nation's railroads.

In summing up the results of the program, Smith termed the exhibit train "the greatest industrial vehicle ever created to benefit customer in-

(*Please turn to page 188*)

Browning Mill Type Cranes
have **PLENTY OF STRENGTH**
where strength is needed!

Satisfying A.I.S.E. specifications, Browning Mill Type Cranes incorporate types of motors and controls on which you have standardized. This flexibility suits your VRB crane *perfectly* to your needs. Our design, springing from 50 years' experience, places plenty of strength where it is required.

"Built as you yourself would build them"

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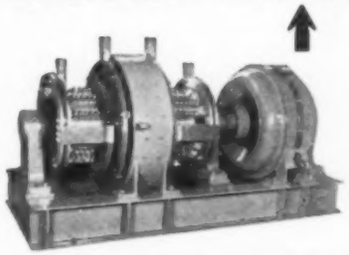
BOX 309, WILLOUGHBY (CLEVELAND), OHIO
Designers and Builders of Electric Overhead Traveling Cranes and Hoists and Electric Revolving Cranes

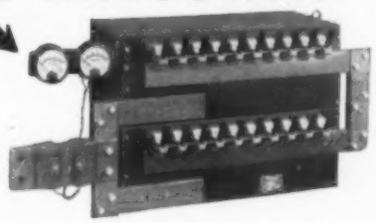
COLUMBIA

MOTOR GENERATORS



for
Electroplating
Anodizing
Electrocleaning
Electropolishing

TANK RHEOSTATS



- TONG TEST AMMETERS
- REVERSING SWITCHES

Write for Descriptive Bulletins

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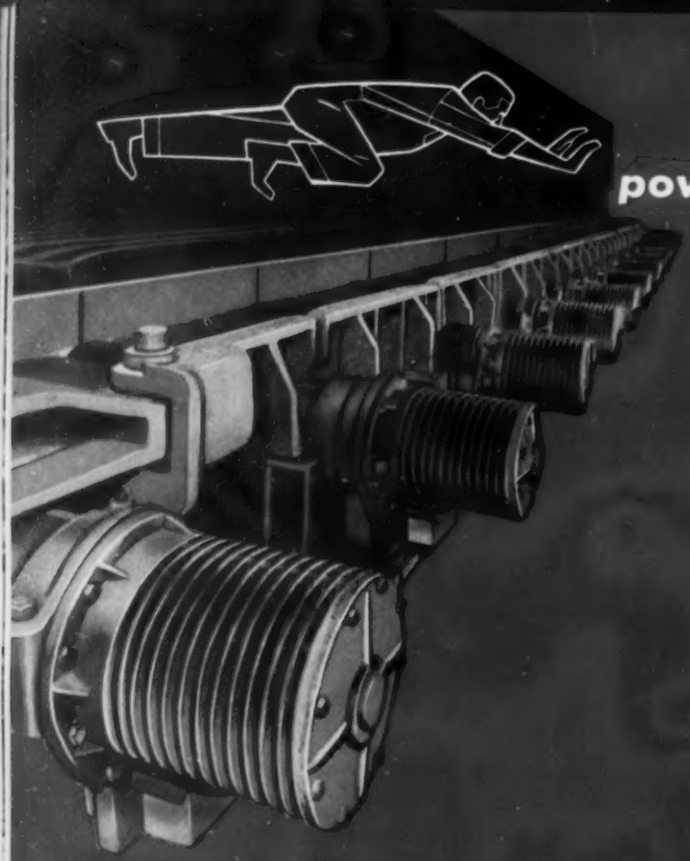

powerful helper for

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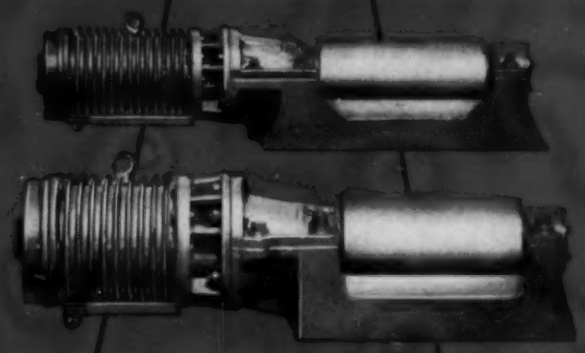

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  Extra sturdy, shockproof, heavy antifriction bearings. Need for flexible couplings eliminated.
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  Ideally suited to constant start-stop operation. Can be safely stalled under full load. Stator insulated to withstand up to 350° F.
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  No special maintenance crews needed. One or two spare rollers sufficient for upkeep of entire installation. Units consume less current than any other roller conveyor.
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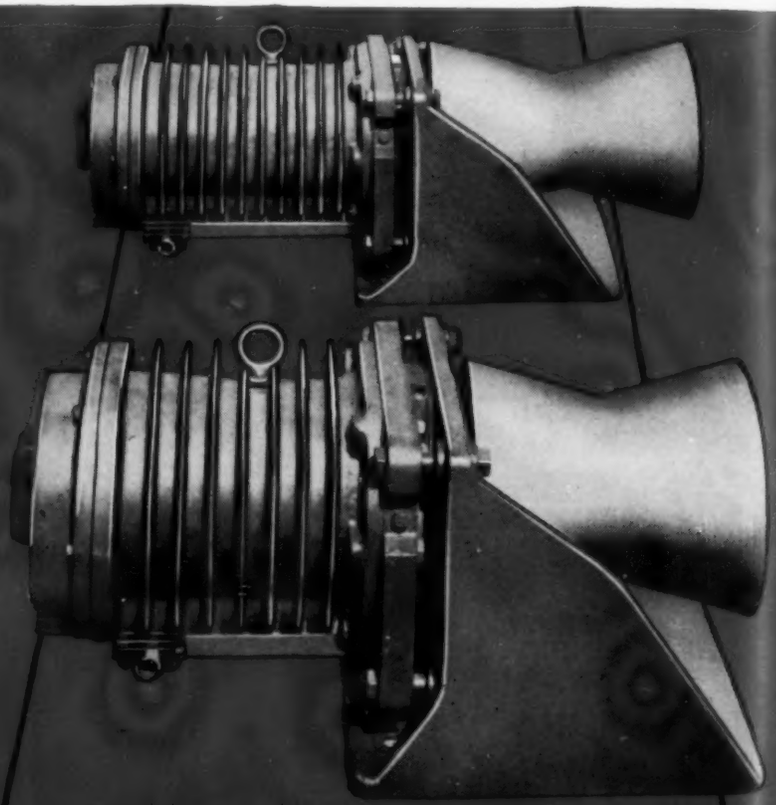

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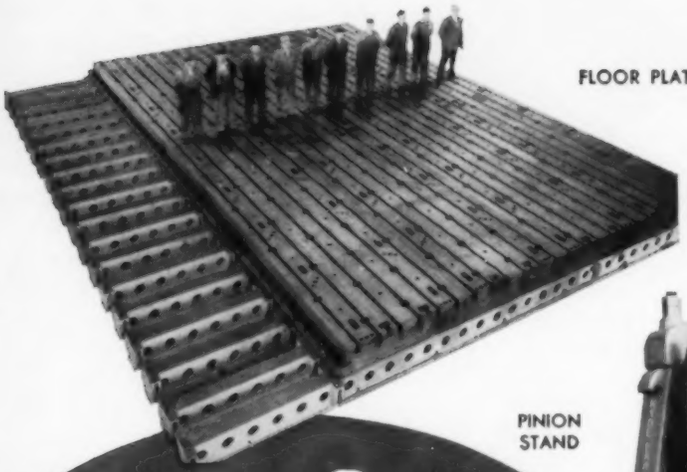
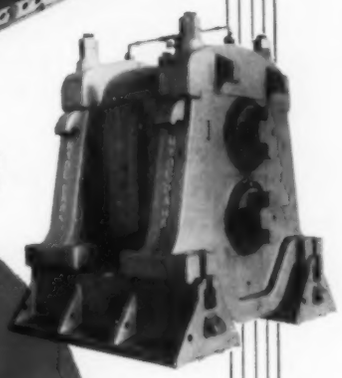
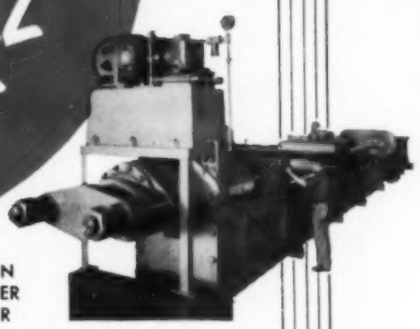


FLOOR PLATE



PINION STAND

Hyde Park ROLLS AND ROLLING MILL EQUIPMENT



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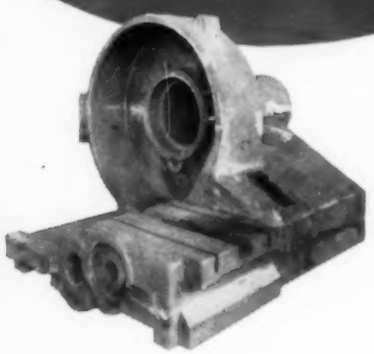
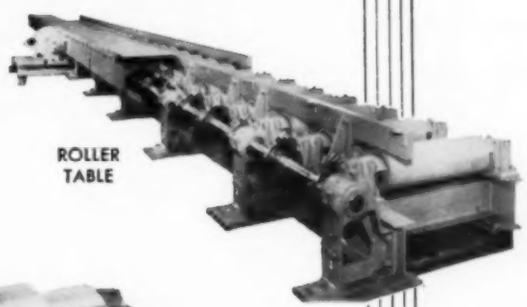


HEAVY MACHINE TOOL CASTING



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Hyde Park Rolling Mill Equipment saves maintenance costs through higher sustained efficiency.

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Up To 80,000 Lbs.

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- Mill Housings
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- Surface Plates

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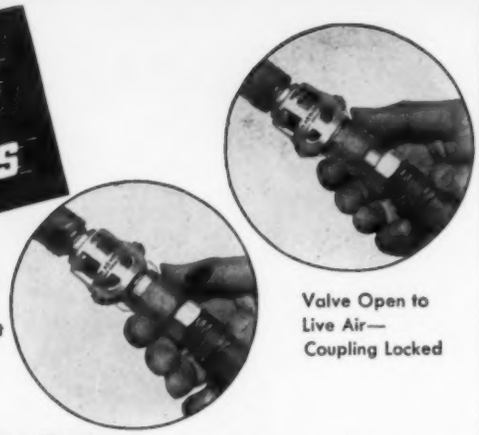
HYDE PARK, WESTMORELAND CO., PA.

Quick-As-Wink
AIR AND HYDRAULIC
Control Valves



Valve Closed to Live Air— Open to Exhaust

Valve Open to Live Air— Coupling Locked

VALVE COUPLINGS ¼", ⅜", ½", & ¾" SIZES

For Economy and Safety

● These couplings permit air to be shut off and tools changed quickly without going to the main shut-off valve. Coupling jaws are automatically self-locking when valve is open to air supply. The coupling cannot be disconnected until the valve sleeve is moved to closed and exhaust position,— thus preventing accidents and injuries. Pressures to 250 p.s.i.—hose shank, male or female pipe connections. *Send for Bulletin No. 104-C. It gives full details and prices.*

THE HIGHER THE PRESSURE THE TIGHTER THE SEAL

Quick-As-Wink
AIR AND HYDRAULIC
Control Valves

Hand, Foot, Cam, Pilot, Diaphragm and Solenoid Operated

Mfd. by C. B. HUNT & SON, INC., 1986 East Pershing St., Salem, Ohio

(*Continued from page 185*)

terests and cement customer relations."

He pointed out that the project was a part of General Electric's "More Power to America" program, a program aimed at peak national production through maximum industrial electrification.

Exhibit Train Statistics:

Miles traveled	28,411
Cities visited	166
Number of Visitors:	
Industrialists, businessmen, civic officials	186,993
College students and faculty	14,668
General Electric officers, stockholders and employees	58,072
Total	259,733

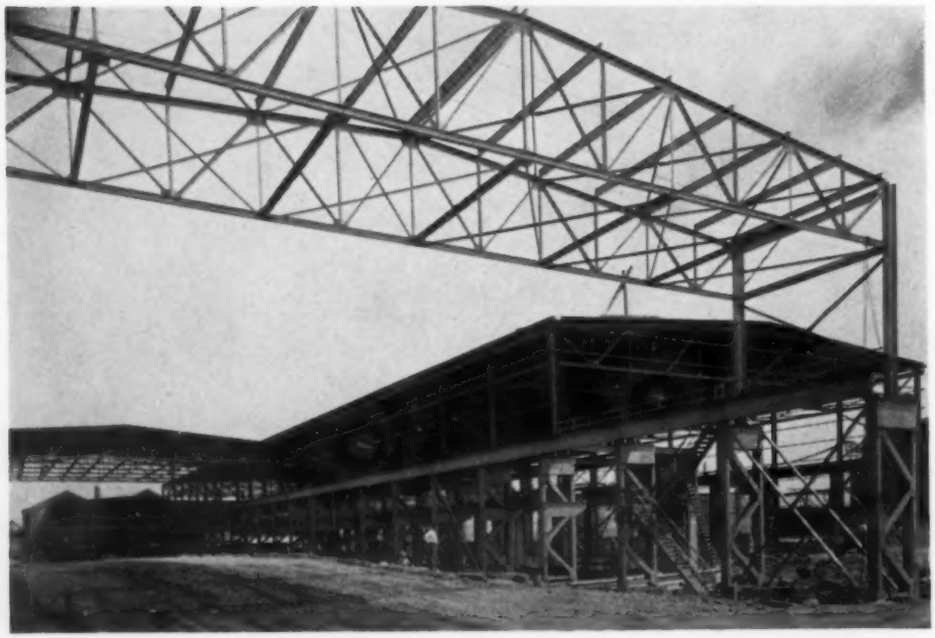
RESEARCH LABORATORIES

To improve its products and to assist customers confronted with unusual problems, National Tube Co. has established a new laboratory at 327 Craft Avenue in Pittsburgh, Pa. Consisting of three stories and a basement, this United States Steel subsidiary's laboratory is provided with

AT THE NEW J&L ROD MILL IN ALIQUIPPA

YORK

- Designed and wrote specifications for all buildings and their foundations and for the motor room.
- Designed foundations for all mill equipment, built by United Engineering & Foundry Company, and for motor room equipment.



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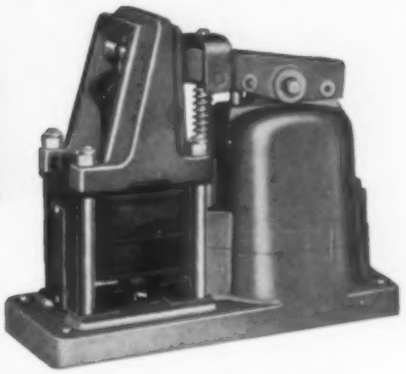
the most modern equipment for testing materials and for conducting extensive research into metallurgical problems.

An entire floor, the third is devoted to electronic measuring devices, a photoelastic stress analysis laboratory, microscopes, oscillographs, and an engineering drafting department. A magnetic detector of soft spots in pipes has been developed here to replace spark testing in some applications. The detector consists of a box-like device that fits over the pipe to be tested. It is basically a transformer with the pipe functioning as the core. As the physical properties of the core vary, so do the voltage and output of the transformer. Sensitive gages, measuring these variations, give an accurate picture of the pipe's characteristics. This test, besides its speed and accuracy, has the advantage of being non-destructive to the material under observation.

For analyzing three-dimensional stresses that occur in pipe joints and threaded unions, a modern photo-

(*Please turn to page 192*)

Quick-As-Wink
AIR AND HYDRAULIC
Control Valves



No. 1491-CS-3
½" 3-Way Solenoid
Operated Air Valve

SOLENOID OPERATED Air Valves

fast, positive, dependable operation

● These valves are widely used for controlling single action air cylinders, clutches, etc. Can be operated with a variety of power switches, mercoid switches or automatic contact switches activated by moving objects. Stainless steel push-pull rods, brass sleeves and U-packings expanded by pressure and all enclosed against dirt, assure long, efficient, trouble-free operation. No metal to metal seating. Precision made. Individually tested. Spring or double solenoid return. ⅜" to 1½" sizes: 2-way, 3-way and 4-way actions. *Write for full details.*

THE HIGHER THE PRESSURE THE TIGHTER THE SEAL

Quick-As-Wink
AIR AND HYDRAULIC
Control Valves

Hand, Foot, Cam, Pilot, Diaphragm and Solenoid Operated

Mfd. by C. B. HUNT & SON, INC., 1989 East Pershing St., Salem, Ohio

FOR LONG RUN ECONOMY

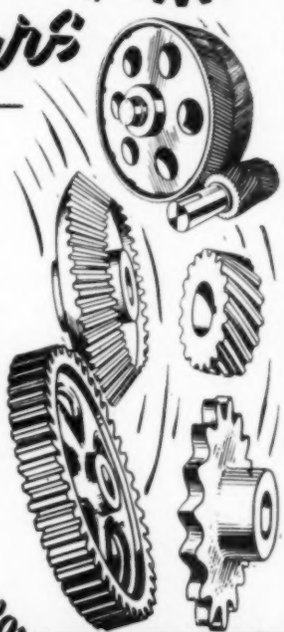
"Industrial Gears"

INDUSTRIAL GEAR MFG. CO. CHICAGO
DUROCASE GEARS
SERVE THE STEEL INDUSTRY

—pay off in smooth, uniform power flow. Specify "I. G." Durocase Gears. Deep case hardening down to the tooth core makes them stand the gaff of Steel Mill Service.

Our modern plant has the latest machines for the production of Gears of all types—Herringbones up to 61 inch diameter, Helicals, Spurs, Bevels, Mitres, Worms and Worm Wheels, Internals, Angular Gears, as well as Racks, Pinions, Splines and Sprockets.

See our completely equipped plant in pictorial form. Write for booklet. Better still, aim that next gear order at us. We'll serve you to your satisfaction.



Industrial Gear Mfg. Co.
4527 W. VAN BUREN ST.
CHICAGO 24, ILL.

Come Up to **STANDARD** *with*
STANDARD CARBON PRODUCTS

No truer measurement of quality can be had than observing a "Standard" brush operating on equipment in the largest mills in the world and some of the largest coal mines.

●

BRUSHES for Rotary Converters • Synchronous Motors • Mill and Crane Motors • Mining Machinery Motors • Large Rolling Mill Equipment • Plating Generators • Everything in the fractional line.

MOLDED PRODUCTS

ELECTRODES Up to 6" Diameter and 40" Long

●

Write for Catalog!

STANDARD CARBON COMPANY

Telephone: 4-1611

P. O. Box 49, STEUBENVILLE, OHIO

SALES OFFICES:

Chicago, Pittsburgh, Detroit, New York, Phoenix, Los Angeles, Logan and Kermit (W. Va.)

They did . . .

Weirton needed more production from this mill. The way to get it—a new drive.

what . . .

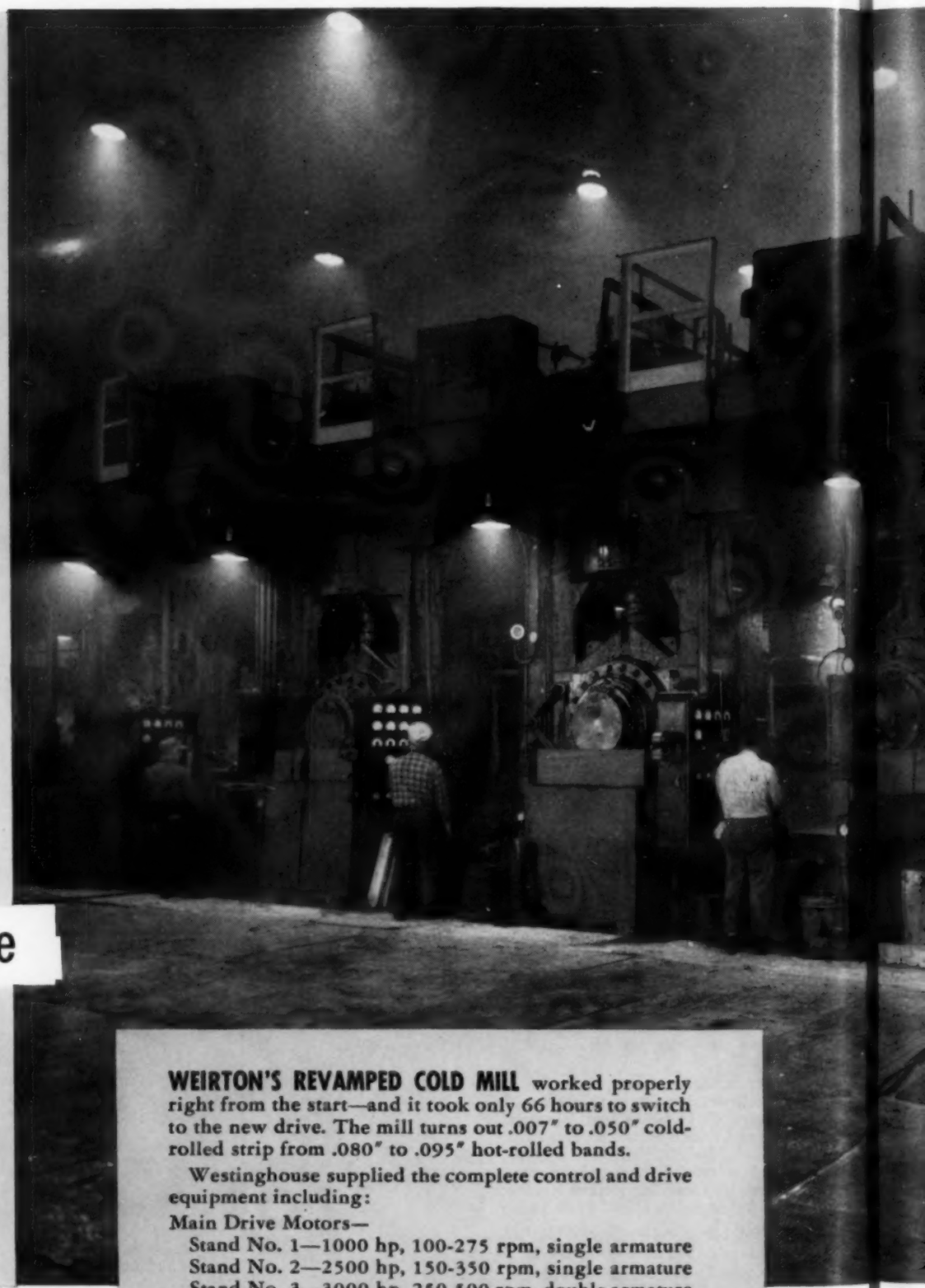
They called in Westinghouse to help engineer the drive. Based on our experience with similar installations, we attacked the problem *as a whole*—and helped them put together *a co-ordinated electrical system.*

you can do . . .

This experience and this method can be applied to *your* next project—whatever it is. Westinghouse can work with you on *all* your electrical needs.

to produce more

The result will be more production, lower costs, better operations—or a combination. Whether you need one motor, or a complex system, Westinghouse can come up with the answer.



WEIRTON'S REVAMPED COLD MILL worked properly right from the start—and it took only 66 hours to switch to the new drive. The mill turns out .007″ to .050″ cold-rolled strip from .080″ to .095″ hot-rolled bands.

Westinghouse supplied the complete control and drive equipment including:

Main Drive Motors—

Stand No. 1—1000 hp, 100-275 rpm, single armature
Stand No. 2—2500 hp, 150-350 rpm, single armature
Stand No. 3—3000 hp, 250-500 rpm, double armature
Stand No. 4—3000 hp, 312-625 rpm, double armature
Reel —600 hp, 180-720 rpm, double armature

Power for the drive motors is supplied by a new four-generator M-G set, along with one existing M-G set from the original drive. Each motor is fed by its own generator.

They sold the FIRST COIL they rolled on this revamped tandem mill!

Weirton Steel had Westinghouse build a complete new drive for this tandem cold strip mill—to boost the speed from 1500 to 3000 fpm. The mill was down only 66 hours for the change-over. And the first new coil they rolled was of salable quality!

PROBLEMS SOLVED AHEAD OF TIME

How were they able to do it in such a short time? It was based on previous Westinghouse strip mill experience. The operating and engineering problems were anticipated—and solved *ahead* of time.

TOTAL DOWNTIME FOR REVAMP: 66 HOURS

The new drive was built alongside the old one, according to an ingenious plan worked out by Weirton and Westinghouse engineers. They changed over while the mechanical equipment was being revamped. The mill was rolling 66 hours later—and it hasn't needed a major adjustment since then.

CALL WESTINGHOUSE EARLY ON EVERY JOB

This is the kind of thinking Westinghouse applies to *all* steel mill electrical projects. Whatever your next job is—a main mill drive, the equipment for an electrical furnace, an auxiliary motor—call your Westinghouse office early in the planning stage. Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pennsylvania. J-94899

YOU CAN BE SURE... IF IT'S

Westinghouse

EQUIPMENT FOR THE STEEL INDUSTRY

NICAD

MADE IN U.S.A.

T-TYPE BATTERY
for
RAILROAD
DIESEL STARTING

2 models—THR-30, THR-44

SAVES UP TO 100 MAN HOURS PER YEAR PER LOCOMOTIVE

Because the NICAD nickel cadmium storage battery requires less maintenance you save precious man hours and, at the same time, are assured of reliable, foolproof battery service throughout its long life. The T-Type NICAD battery has an exceptionally high ampere rate of discharge at useful voltage, a vital consideration in engine-starting applications.

BATTERY TYPE	AMPERE HOURS	NUMBER OF CELLS	GROUP TRAY LENGTH A	TRAY WIDTH B	WEIGHT LBS.
THR 30	142	48	33¼"	8"	1825
THR 44	210	48	44⅛"	11"	3675

THR-30—Interchangeable with 17-plate, 248 A.H. Lead Acid Batteries
THR-44—Interchangeable with 25-plate, 426 A.H. Lead Acid Batteries

NICAD IS LIGHTER, NEEDS NO ADDITIONAL SPACE

Exceptionally Long Life
Low Cost Operation
Negligible Water Consumption
Low Internal Resistance
Rugged Steel Construction
Very Low Self-Discharge

Uses Standard Charging Equipment

Other NICAD Applications in:
UTILITIES HEAVY AUTOMOTIVE
MARINE RAPID TRANSIT
LABORATORIES

NICAD

NICKEL CADMIUM BATTERY CORPORATION
100 Park Ave. New York 17, N. Y.
Factory—Easthampton, Mass.
Chicago Office—30 N. La Salle St.

MADE EXCLUSIVELY IN THE U.S.A.

(*Continued from page 189*)

elastic stress analysis laboratory is available. In this area is a special camera and lenses with a polaroid light source. Fosterite plastic, an olive drab, translucent material, is molded into the form of the pipe joint to be studied. This plastic has the property of being able to freeze the stresses it undergoes so that, under polarized light, the stress forms and patterns become visible and can be photographed for study.

For measuring impact stresses and other stresses of short duration, the laboratory is equipped with a cathode-ray oscillograph capable of photographing tests at rates varying from 1 inch of film a minute to 60 inches a second.

Metal structures are studied in a standard metallurgical microscope with 2,500 diameters maximum magnification. Auxiliary equipment for mounting samples consists of a cut-off wheel, mounting press, wet grinders, and wheel polishers. There are two dark-rooms for developing prints and negatives.

On the second floor are the offices of William O. Clinedinst, director of research for National Tube Co., and Walter P. Benter, manager of the research laboratory, as well as the conference room and research library, an extensive creep test laboratory, and equipment for hardness and other testing of steel products.

Standard equipment is available for conducting Vickers, Brinell, and Rockwell hardness tests. There is a muffle furnace for heat treating samples and test specimens, and spray quenching facilities are provided. The laboratory is also equipped for Jominy end-quench harness tests.

In this laboratory mill safety hats undergo dielectric and impact tests. Safety shoes and other mill clothing are tested for strength, fire resistance and other qualities.

As a conservation measure, a search for adequate coating materials for tubular products is constantly underway in National Tube Co. At the Craft Avenue laboratory, a special installation of equipment for such experiments occupies a room on the second floor. Here a hydrogen atmosphere furnace is used to heat tubular specimens prior to coating them with the non-ferrous materials under study. A special machine measures and records furnace temperatures.

On this floor also is complete equipment for creep and creep-rupture tests. For investigating and determining the elevated temperature properties of steels used in the manufacture of tubular products, there are 18 lever-type creep stands in operation. For short-time elevated temperature tests there are two screw-driven, spring-loaded machines which may be used for both tensile and creep-rupture testing. To assure accuracy, the entire creep-rupture laboratory is air-conditioned.

To protect the creep testing from any interruptions due to possible failure of city power, a standby generator is installed in the basement of the laboratory. This is a standard, gas-motored installation which can be cut in the moment the regular power source fails.

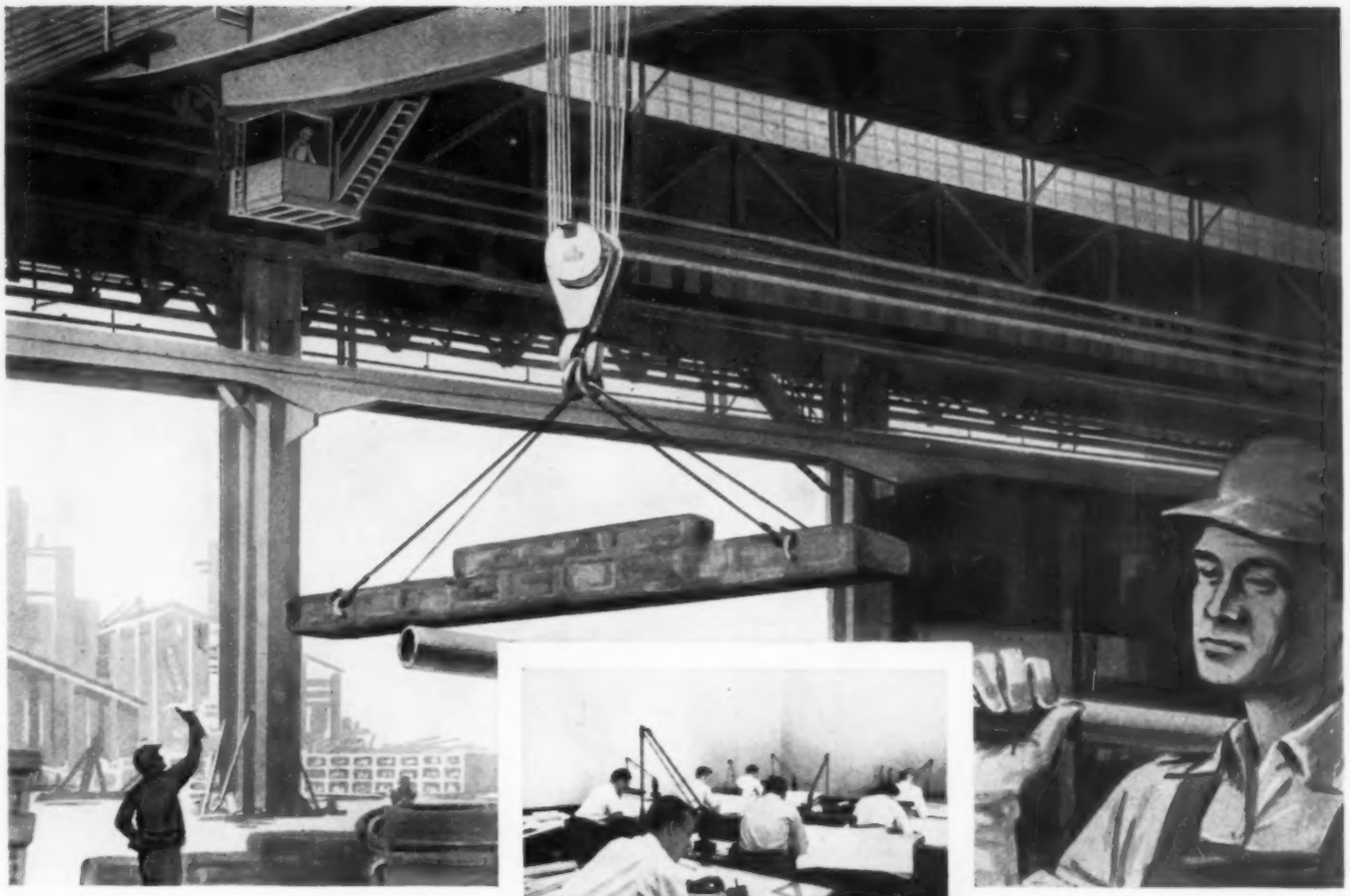
The largest installation on the first floor is the modern and fully equipped machine shop, where parts for maintenance and repair of the many testing facilities in the laboratory are fabricated. The machine shop also cuts, turns, and polishes steel samples in necessary sizes and shapes for each of the various hardness tensile, creep, fatigue, and other tests.

There is a complete chemistry laboratory on this floor and two rooms have been set aside for facilities to test lubricants, not only for National Tube Co. but for other subsidiaries of U. S. Steel, as well.

Across the hall from the chemistry laboratory are eight fatigue testing machines where specimens of pipe wall are subjected to varying loads while they are rotated at speeds up to 10,000 revolutions a minute. Some of the tests are conducted under corrosive conditions encountered in actual service.

One of the impressive tests conducted at the Craft Avenue laboratory is the tension-collapse test. In a high-compression hydraulic cylinder a section of pipe under tension is subjected to water pressure until it collapses. The cylinder is mounted in a concrete pit and as an added safety precaution all controls and gages are mounted behind a safety wall. In the same room another concrete pit is equipped with machinery to subject pipe to internal water pressure to the bursting point.

(*Please turn to page 202*)



KULJIAN ENGINEERING saves manpower for STEEL

Kuljian engineering services often save manpower in more than one way. There is the obvious saving of load on the client's own engineering staff when growing needs for plant space or modifications require extra engineering help in designing and supervising new construction.

Then there is the saving of production manpower when new plant design provides for greater efficiency, faster internal transportation, and use of mechanical improvements to increase production per man-hour. In this type of saving, Kuljian brings to your undertakings fresh viewpoints and long experience.

The Kuljian organization is a corps of specialists fully coordinated, with seasoned competence and collective ability to undertake full responsibility for the largest industrial projects. A phone call or letter will bring a Kuljian engineer to your desk promptly for conference.

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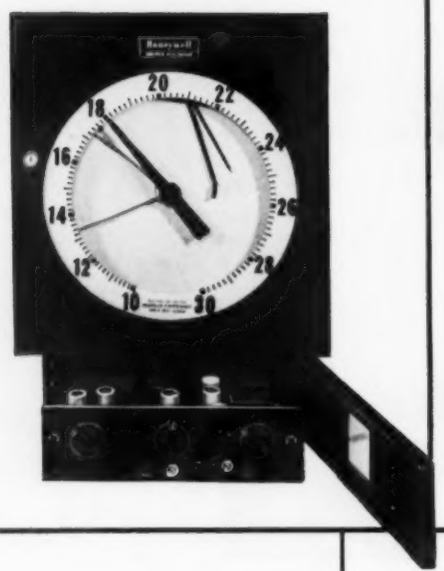
The **Kuljian** *Corporation*

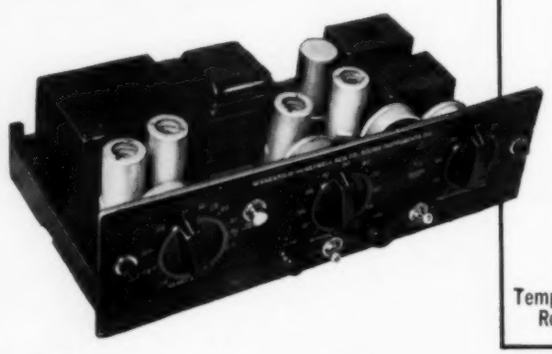
ENGINEERS

1200 NORTH BROAD STREET, PHILADELPHIA 21, PA.

Here's Better Control for your Furnace or Process

BROWN INSTRUMENTATION IS THE *Plus-Factor*





Electr-O-Line

Position - proportioning control with automatic reset... Electr-O-Line.

Electric Proportional Control Relay

With Automatic Reset

*The **Electr-O-Line** delivers a continuous heat input which is modulated according to exact process requirements. Individual control adjustments are included for proportional band, reset rate, approach rate and sensitivity. For complete information write for Specification Number 194.*

Electr-O-Pulse

Time-Proportioning control with automatic reset... Electr-O-Pulse.

Electric Proportional Control Relay

With Automatic Reset

*The **Electr-O-Pulse** delivers an intermittent full heat input which is modulated on a pulse/time basis according to exact process requirements. Individual control adjustments are included for proportional band, reset rate, approach rate (optional) and cycle time. For complete information write for Specification Number 195.*

Electr-O-Line and *Electr-O-Pulse* proportional control relays provide the sensitivity and accuracy required for the most critical control problems. The control adjustments are totally independent of each other, an exclusive feature.

Thus, when one control adjustment is changed, the others are not upset. The relays are designed to withstand severe industrial conditions, and are unaffected by vibration . . . compact unit construction makes for easy installation and service. Both are available mounted integrally with the *ElectroniK* proportional controller, or separately for modernizing existing installations . . . both produce the same straight line control.

Your local Honeywell engineer can give you recommendations for control systems utilizing these relays, or any other type of control, to suit your specific requirements. Call him in today . . . he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4464 Wayne Ave., Philadelphia 44, Pa. Offices in more than 80 principal cities of the United States, Canada and throughout the world.

MINNEAPOLIS **Honeywell**

Brown Instruments

AMPCO* Screw-down NUTS

Pay off under pressure!

Help maintain record-breaking tonnages by holding downtime to a minimum . . .

Tough? You bet. That's why Ampco screw-down nuts stand up under the tremendous impact and loads developed in blooming-mill operations. They pay off under pressure — keep production up, costs down.

Ampco screw-down nuts are usually centrifugally cast for the sound structure so necessary to provide the tough wear resistance you want. And you can get them in sizes up to 6000 lbs.

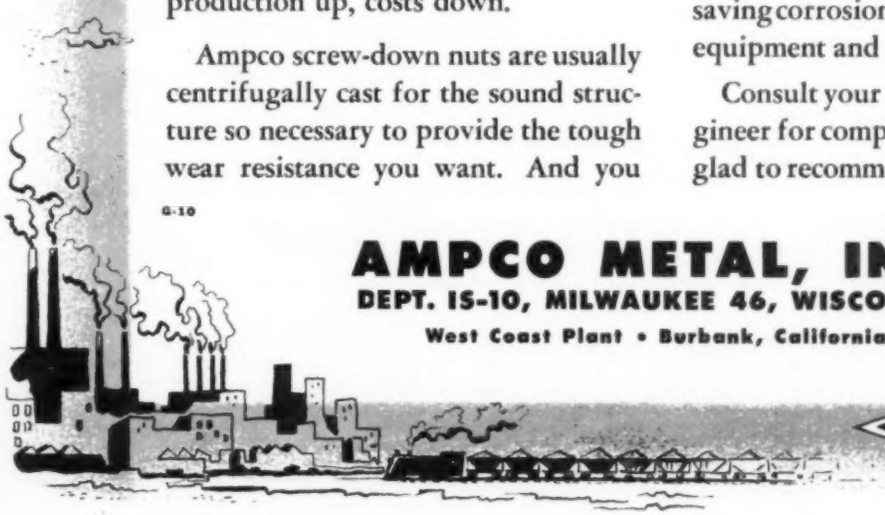
Ampco Metal pays off in other critical production jobs as well — providing extra toughness for wearplates, slippers, flash welder dies — and cost-saving corrosion-resistance for pickling equipment and similar applications.

Consult your nearby Ampco field engineer for complete details—he will be glad to recommend Ampco economies.

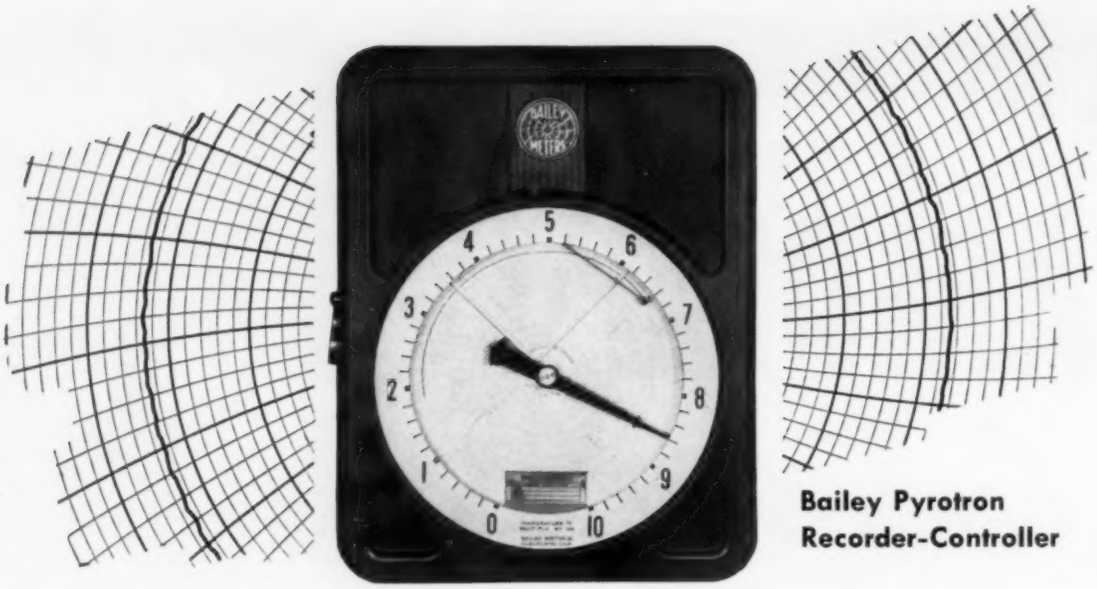
G-10

AMPCO METAL, INC.
DEPT. IS-10, MILWAUKEE 46, WISCONSIN
West Coast Plant • Burbank, California

*Reg. U. S. Pat. Off., Ampco Metal, Inc., Milwaukee, Wis.



AMPCO®



Bailey Pyrotron
Recorder-Controller

Looking for Better Temperature Instruments?

. . . Then check these features of Pyrotron Electronic Resistance Thermometers . . .

FUNDAMENTAL ACCURACY

Bailey Pyrotron Resistance Elements are made of highest purity platinum—the material used by the National Bureau of Standards in establishing basic standards for temperatures from −190°C to +660°C.

THREE TYPES OF CONTROL

Pyrotron Controllers may operate: on-off electrical systems by either electronic relays or electric contacts, modulated electronic systems, or air-operated systems. Two temperatures may be recorded on the same chart and controlled by a single instrument.

FACTS PUT INTO USABLE FORM

Bailey Pyrotrons may be arranged to put temperature facts into convenient usable forms. If two or more temperatures are related, they may be recorded as continuous records on the same chart for easy comparison. The average of several temperatures or the difference between two temperatures may be recorded as a single continuous record which may be retransmitted to a distant point or used to actuate a control system.

EASY INSTALLATION

Bailey Pyrotrons do not require careful leveling or protection against vibration. Three ordinary copper wires are all that is needed to connect each temperature sensitive element with the recorder. Power may be taken from any 115 volt 60 cycle circuit.

MINIMUM MAINTENANCE

The absence of galvanometers, batteries and standardizing equipment, together with the use of interchangeable unit assemblies, reduces Pyrotron maintenance to the vanishing point.

ABUNDANT POWER

A separate motor drive for each temperature furnishes abundant power to operate a recording pen, a controller and an alarm switch.

For the full story on this unusual electronic resistance thermometer which is suitable for ranges between −300°F and 1200°F, ask for Bulletin No. 230-C. P-21

BAILEY METER COMPANY

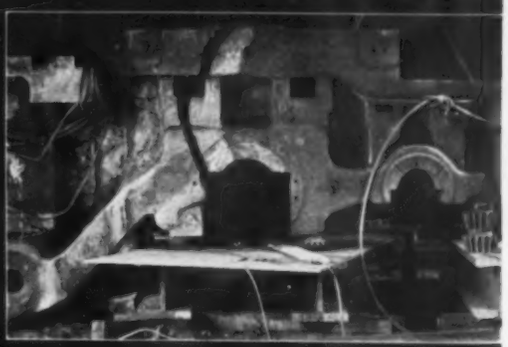
1047 IVANHOE ROAD • • • CLEVELAND 10, OHIO

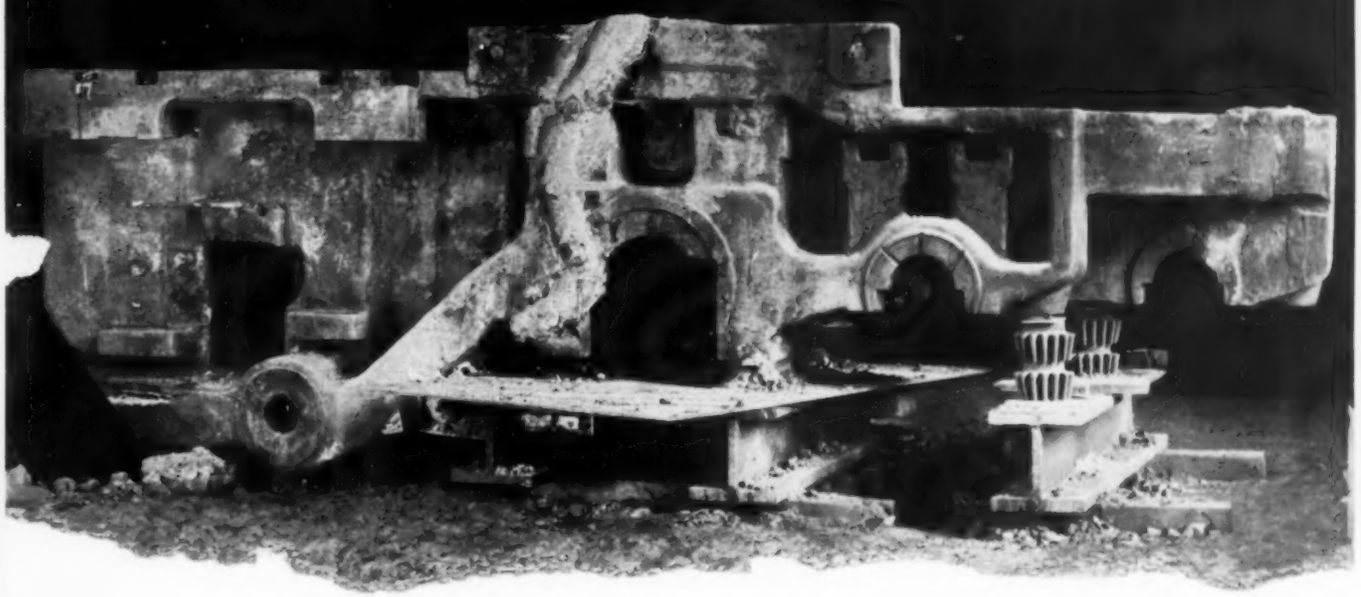
Controls for Processing

TEMPERATURE
PRESSURE
% OXYGEN
% COMBUSTION
FLOW
LEVEL
DENSITY
RATIO

THERMIT

repairs a shear housing and breaks a production bottleneck





Shortly before this big blooming mill shear housing went down its owners, realizing the equipment was operating on borrowed time, contemplated replacement. Unfortunately the housing cracked wide open before the order was placed and important production was threatened.

Here, as in so many like cases, an emergency was met speedily at a fraction of replacement cost by means of Thermit repair. New equipment is carrying the load now but throughout the old housing's remaining term of service Thermit welds held fast and showed no signs of weakening.

Investigate! Steel mill maintenance jobs are done more easily, more quickly and at lower cost by welding with Thermit. Write for complete information.

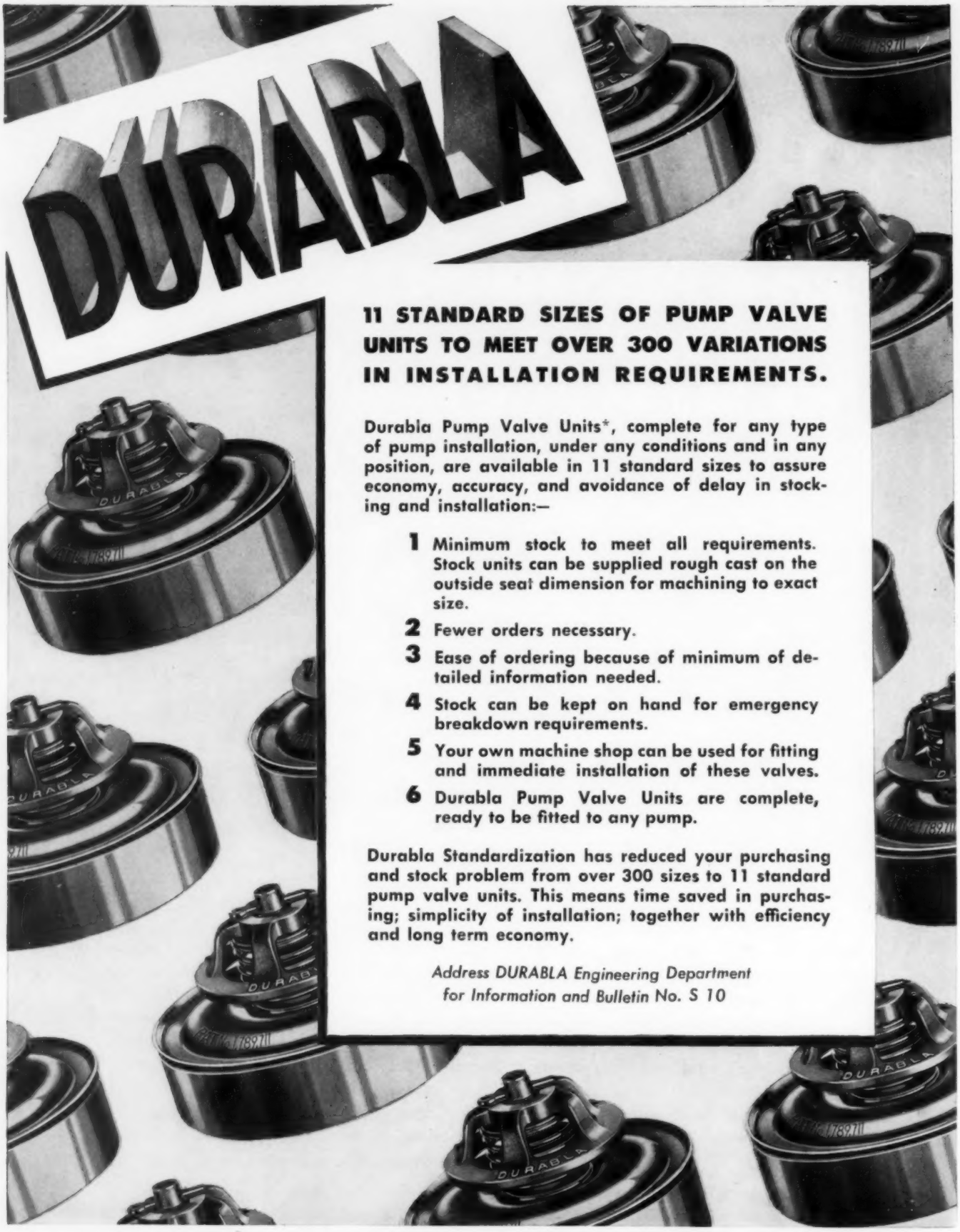
THERMIT WELDING

METAL & THERMIT CORPORATION

100 EAST 42nd STREET NEW YORK 17, N. Y.

NEWARK • PITTSBURGH • CHICAGO

PHILADELPHIA • SO. SAN FRANCISCO



11 STANDARD SIZES OF PUMP VALVE UNITS TO MEET OVER 300 VARIATIONS IN INSTALLATION REQUIREMENTS.

Durabla Pump Valve Units*, complete for any type of pump installation, under any conditions and in any position, are available in 11 standard sizes to assure economy, accuracy, and avoidance of delay in stocking and installation:—

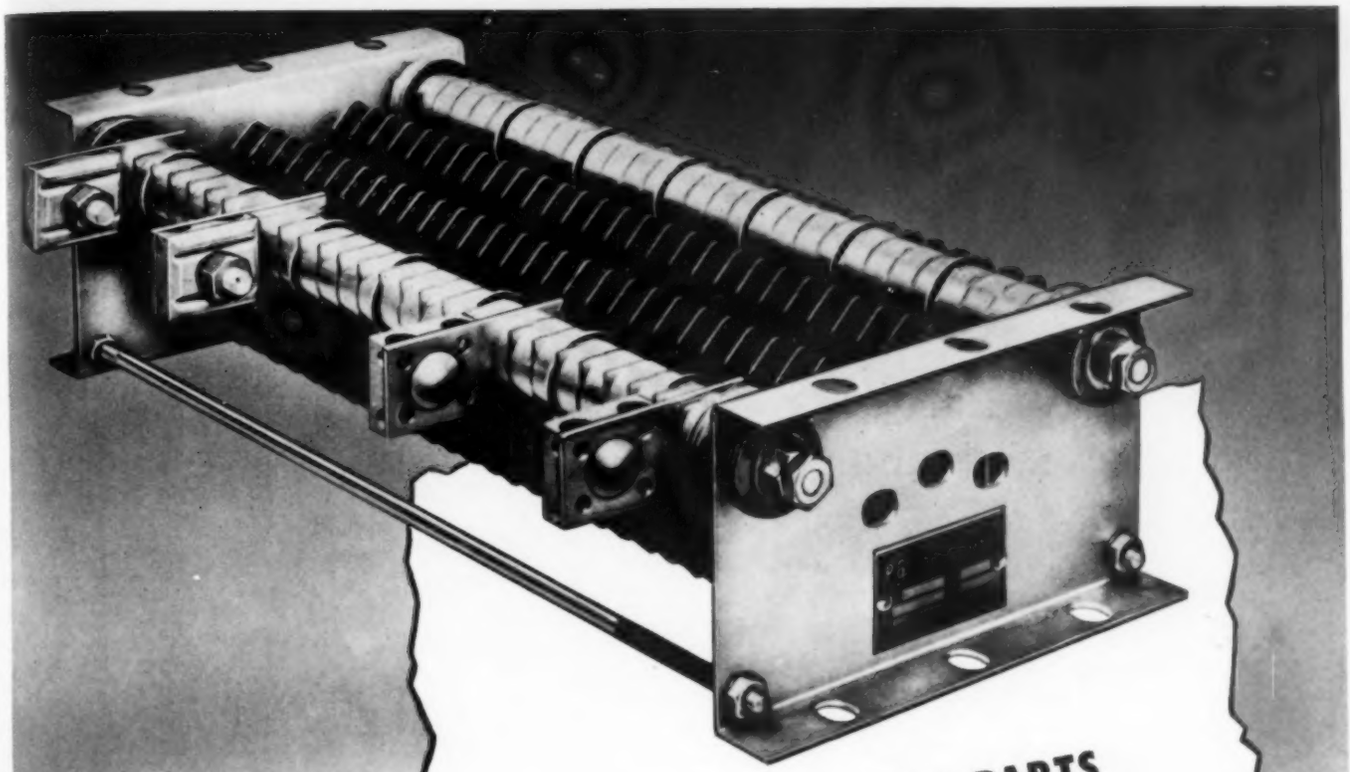
1. Minimum stock to meet all requirements. Stock units can be supplied rough cast on the outside seat dimension for machining to exact size.
2. Fewer orders necessary.
3. Ease of ordering because of minimum of detailed information needed.
4. Stock can be kept on hand for emergency breakdown requirements.
5. Your own machine shop can be used for fitting and immediate installation of these valves.
6. Durabla Pump Valve Units are complete, ready to be fitted to any pump.

Durabla Standardization has reduced your purchasing and stock problem from over 300 sizes to 11 standard pump valve units. This means time saved in purchasing; simplicity of installation; together with efficiency and long term economy.

Address DURABLA Engineering Department for Information and Bulletin No. S 10

* Patent Numbers 2090486, 2117504

DURABLA MANUFACTURING COMPANY
114 LIBERTY ST. NEW YORK
BRANCHES IN PRINCIPAL CITIES. FOR CANADA REFER: CANADIAN DURABLA LIMITED, TORONTO



REDUCE INVENTORIES OF MAINTENANCE PARTS

. . . with P-G *Steel Grid Resistors . . .*

Post-Glover Standard Resistor Units, of identical dimensions, are produced in a wide variety of resistance values and capacities.

In combination, they give complete resistor values for practically any motor control desired.

Because comparatively few types are necessary in the supply room, maintenance repairs are made with the utmost speed and a minimum investment.

A P-G sales engineer will be glad to explain . . . in detail . . . how you can save with the Nonbreakable Steel Grid Resistor.

ALL STEEL CONSTRUCTION
MICA INSULATION
RUGGED TERMINALS
PROVISION FOR EXPANSION
ADEQUATE VENTILATION
UNAFFECTED BY VIBRATION
MOISTURE RESISTANT
CORROSION PROTECTED

Write for Bulletin No. 500

P-G

The Nonbreakable Steel Grid Resistor

THE POST-GLOVER ELECTRIC COMPANY

• ESTABLISHED 1892 •

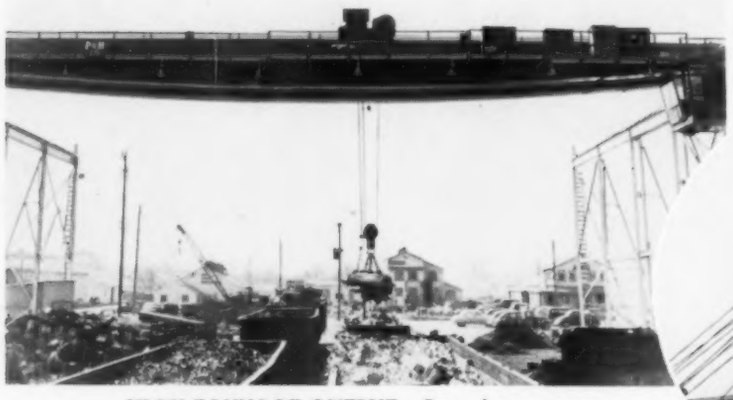
221 WEST THIRD STREET, CINCINNATI 2, OHIO

WHERE FAST PICK-UP *Ups* PROFITS

Fast circulation of scrap is paying a good return now! And at today's high prices, efficient and modern equipment raises the rate of return. The EC&M ALL-WELDED Lifting Magnet *sweeps clean* all incoming shipments, reduces baler charging-time with full lifts—and the EC&M Automatic-Discharge Controller cuts down the time between magnet trips. The adjustable feature gives fast, clean releases without waiting and with minimum spillage. *When buying electric cranes, it pays to specify both EC&M Control and Magnets.*

For COMPLETE FACTS—Ask for No. 29 ACCELERATOR Bulletin

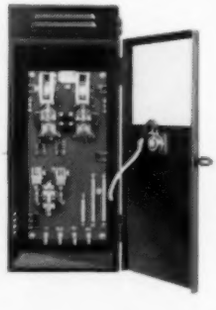
SAVES PREPARATION TIME—10-Ton Gantry Crane with EC&M Control and No. 6D EC&M ALL-WELDED Magnet.



HIGH TONNAGE OUTPUT—One of many overhead scrapyard cranes equipped with EC&M Crane Control and EC&M Magnets.

SCRAP GATHERED FAST with NEW EC&M Magnet on runabout cranes.

ALL-OUT! EC&M Magnet sweeps car bottoms clean—keeps material on the move.



Adjustable EC&M Controller *improves* magnet operation—for use with any make or size of magnet.

THE ELECTRIC CONTROLLER & MFG. CO.
2698 EAST 79TH STREET • CLEVELAND 4, OHIO

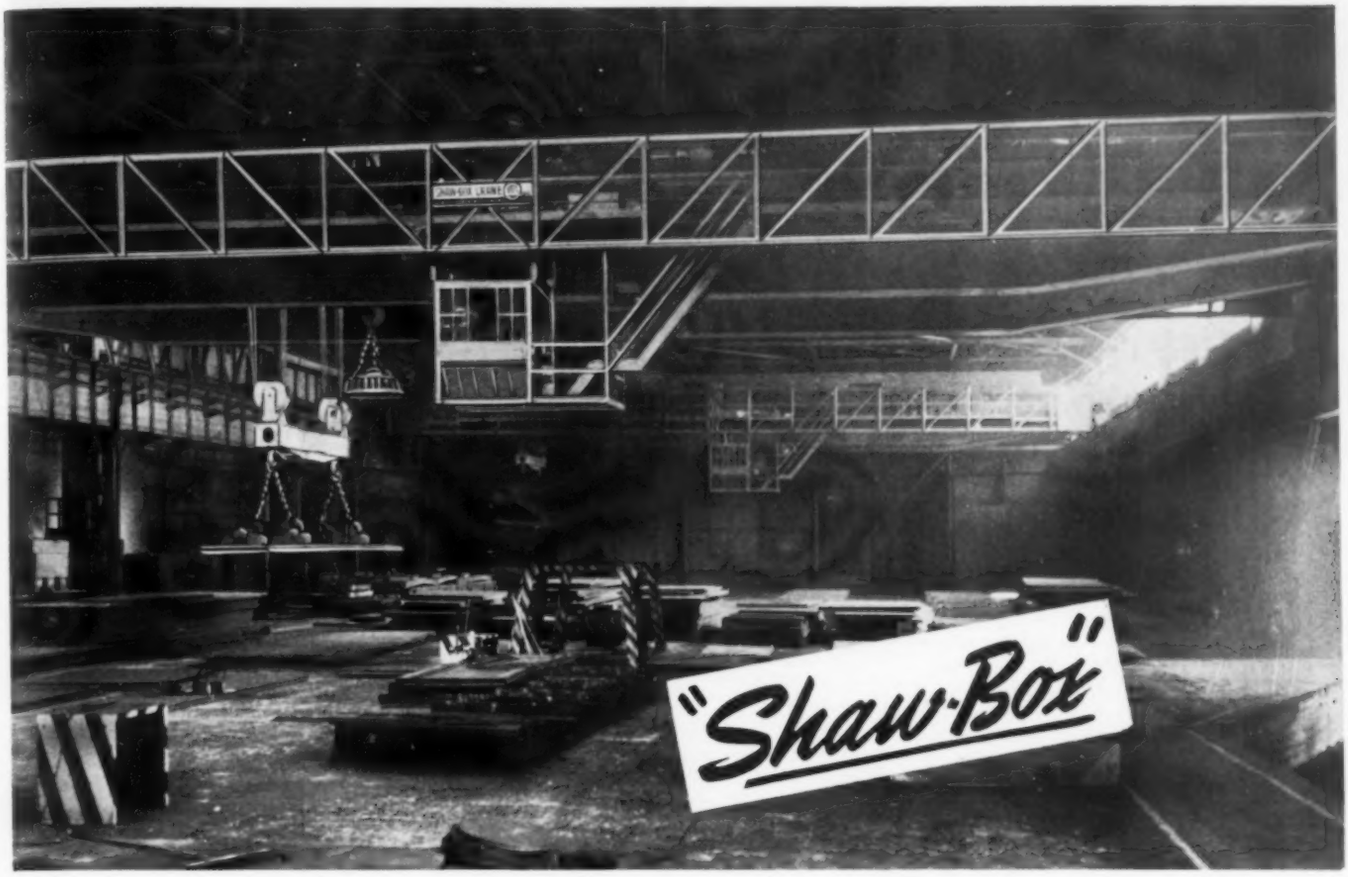


PLATE HANDLING CRANES

When your Plate Handling Cranes are "Shaw-Box," they are engineered for dependability, and built to deliver long years of outstanding service. They completely meet all demands of tough lifting operations, with a minimum of attention and under the most severe operating conditions.

Building Steel Mill Cranes has been a "Shaw-Box" specialty for many years. The cranes they produce are well known for the fine engineering details and precision workmanship employed in the interpretation of individual mill or AISE crane specifications. The dependability of "Shaw-Box" Steel Mill Cranes has been thoroughly proved by years of hard, round-the-clock use in many mills.

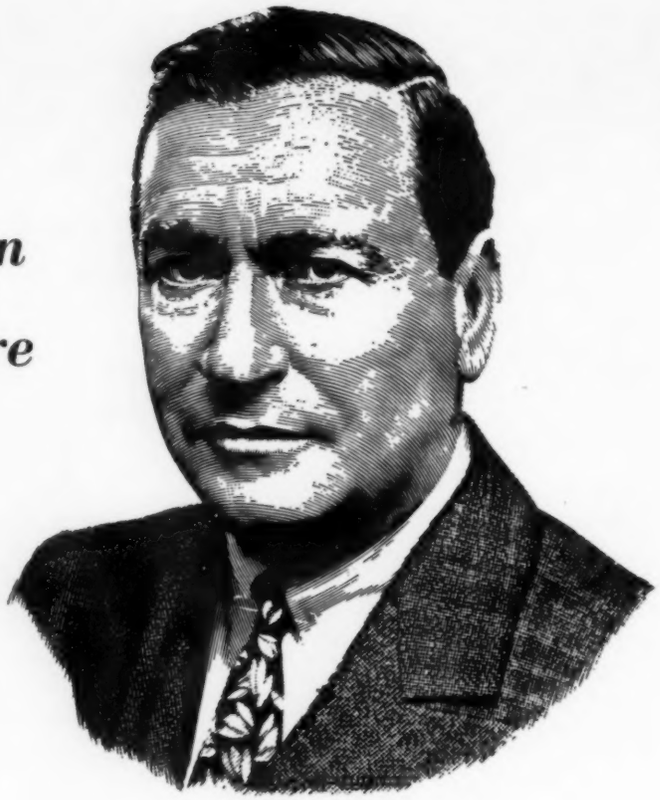
These features and advantages add up to reliable, economical crane service. All "Shaw-Box" Cranes are available at attractive prices.

Be sure to send all your inquiries for Steel Mill Cranes and Soaking Pit Carriages to "Shaw-Box."

MANNING, MAXWELL & MOORE, INC.
SHAW-BOX CRANE & HOIST DIVISION
MUSKEGON, MICHIGAN

Builders of "Shaw-Box" Cranes, 'Budgit' and 'Load-Lifter' Hoists and other lifting specialties. Makers of 'Ashcroft' Gauges, 'Hancock' Valves, 'Consolidated' Safety and Relief Valves, and 'American' Industrial Instruments.

"You Build for your own and your country's future when you save . . ."



BENJAMIN F. FAIRLESS

President, U. S. Steel Corporation

"A free economy, such as ours, is built on the savings of the people. And the future security of America depends on the initiative and the growth of every citizen. We in U. S. Steel encourage our employees to join the Payroll Savings Plan, and we are proud that the National Tube Company, one of our subsidiaries, was the first of the large industrial companies of the nation in 1950 to have more than 80% of its employees participating. Remember, you build for your own and your country's future when you save."

Mr. Fairless is not expressing a personal opinion, nor is he speaking for other far-seeing executives when he tells you that our economy is built on the savings of the people and a man builds for his own and his country's future when he saves.

Actually, Mr. Fairless is merely putting in words the thoughts and action of the millions of employed men and women who *now hold* more than 50 billion dollars in U.S. Savings Bonds.

$50,000,000,000! Who *sold* all those bonds to millions of people? The answer is, nobody sold them.

80% of the employees of the National Tube Company . . . 75% of the employees of Carnegie-Illinois Steel Company . . . thousands of employees of other U.S. Steel subsidiaries . . . more than 8 million employees of other companies bought U.S. Savings Bonds and are buying them every month on the easy, automatic Payroll Savings Plan. Their employers merely offered these men and women an opportunity to save for their future. There was no pressure, no emotional appeal.

How does employee participation in *your* Payroll Savings Plan match up with the 80% of National Tube, the 75% of Carnegie-Illinois? Or, perhaps you are one of the relatively few large companies that do not have a Plan? In either case, wire or write, Savings Bond Division, U.S. Treasury Department, Suite 700, Washington Bldg., Washington, D.C. Your State Director is ready to help you with a package plan—application blanks, promotional material, practical suggestions and all the personal assistance you may desire.

The U. S. Government does not pay for this advertising. The Treasury Department thanks, for their patriotic donation, the G. M. Basford Company and

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EQUIPMENT NEWS

(*Continued from page 192*)

CENTRIFUGAL TACHOMETER

▲ The popularity of the Dr. Horn centrifugal hand tachometer never died even during the past several years when Dr. Horn's plant in Germany was out of commission. Once more these instruments are available through James G. Biddle Co.

This new instrument is basically the same as was offered previously. It boasts six ranges covering from 25 to 30,000 rpm in one instrument; is protected against damage from overspeeding; is simply constructed and requires a minimum of maintenance.

This centrifugal hand tachometer has six ranges from 25 to 30,000 rpm.

It is a sturdy instrument capable of performing dependably for many many years and is priced moderately for a multi-range tachometer.

DRY TYPE TRANFSORMER

▲ Pennsylvania Transformer Co. introduces a new line of dry type transformers with Class H insulation for station auxiliary, unit substation and network service. These transformers are available as ventilated or sealed-in-nitrogen units. The ventilated transformers are manufactured in ratings up to 3000 kva and in voltages up to 15 kv, and the sealed-in-nitrogen transformers are made in

Recently introduced is a new line of dry type transformers with Class H insulation.

sizes up to 2000 kva, 15 kv and below.

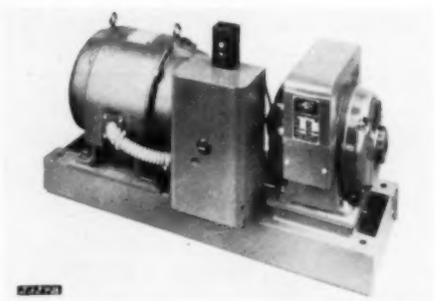
These transformers are fire-resistant, explosion-resistant, moisture-repellent and heat-stable. The insulation as used in transformers consists of inorganic materials such as glass, porcelain and asbestos bonded or impregnated by the silicone resins or rubbers, or by the fluorocarbon resins.

Exposed to air, Class H insulation has about 100 C. temperature advantage over Class B insulation. In their various forms, combined with inorganic materials, silicones permit operating temperatures higher than those permitted for comparable organic materials.

MOTOR GENERATOR SET

▲ Used to convert 60 cycle current to 180 cycle and 360 cycle frequencies, is this new mono-coil high frequency motor generator set built by Electric Machinery Mfg. Co., Minneapolis, Minn. This equipment finds its greatest use in plants using high-cycle automatic electric hand tools such as grinders and buffers. These sets are self exciting and have built-in voltage regulation which automatically compensates for fluctuations in voltage to the load.

The compact, easily installed unit shown is 6 kw, 360 cycles, 3600 rpm. Many other ratings and speeds are available.



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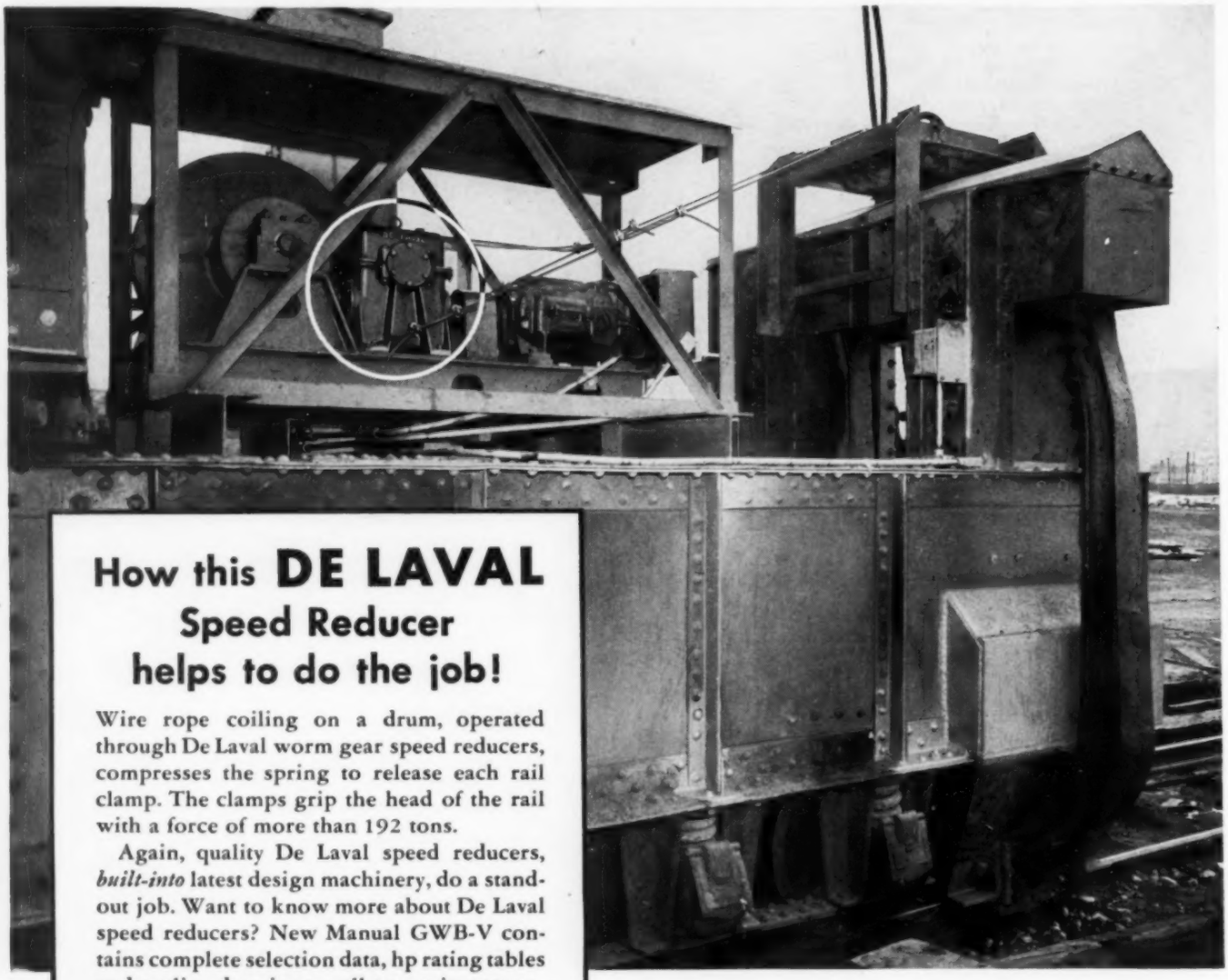

How this DE LAVAL Speed Reducer helps to do the job!

Wire rope coiling on a drum, operated through De Laval worm gear speed reducers, compresses the spring to release each rail clamp. The clamps grip the head of the rail with a force of more than 192 tons.

Again, quality De Laval speed reducers, *built-into* latest design machinery, do a stand-out job. Want to know more about De Laval speed reducers? New Manual GWB-V contains complete selection data, hp rating tables and outline drawings...all set up in easy-to-use form. Write for your copy today.

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DE LAVAL *Speed Reducers*

BUILT TO BE *BUILT-INTO* A QUALITY PRODUCT

DE LAVAL STEAM TURBINE COMPANY • TRENTON 2, NEW JERSEY

DL1CC

Weldco Mechanical Pickler in major Ohio steel plant, operated with two 600 AT and one 300 AT Cleveland Speed Reducers. Photo by courtesy of Youngstown Welding & Engineering Company.

Unique mechanical bar pickler driven by three CLEVELANDS

THIS pickler descales steel bars prior to cold drawing. The excellence of its work depends on its drive. An unusual arrangement of three Cleveland Worm Gear Speed Reducers lowers and raises the bars in and out of the tank at a prescribed rate, resulting in thoroughly uniform, complete descaling at low cost. No overpickling and no underpickling!

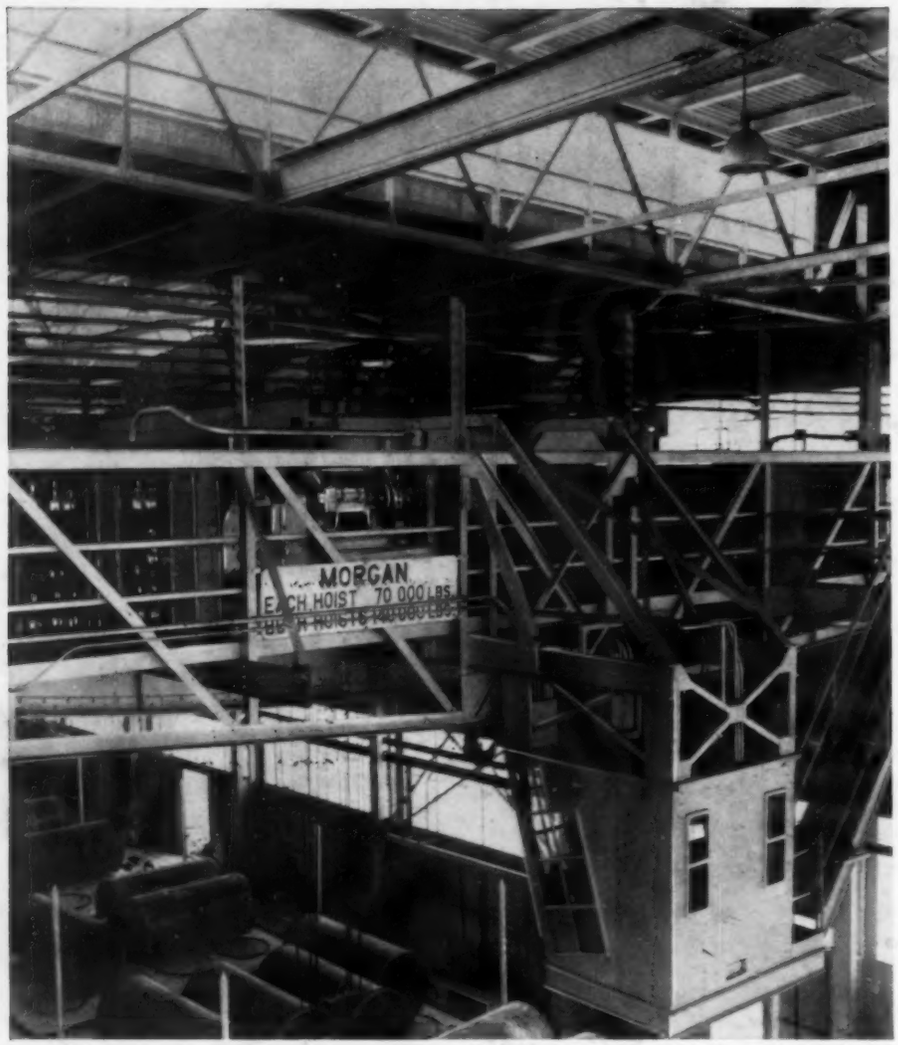
For any job where a powerful, trouble-free, right-angle drive is desired, Cleveland is first choice. Wherever they serve, engineers know from experience that they can depend on Clevelands. They give satisfactory service, no matter how severe the conditions.

Cleveland sales representatives are ready to discuss your power transmission needs with you—help you select correct types and sizes.

For specifications and other details, write for our current catalog. The Cleveland Worm & Gear Company, 3278 East 80th St., Cleveland 4, Ohio.

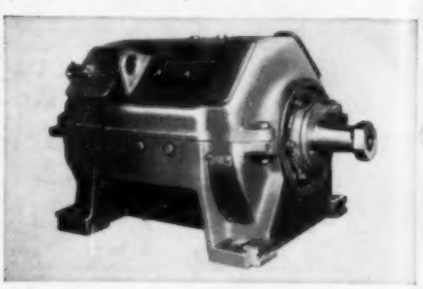
Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers Limited.

CLEVELAND
Worm Gear
Speed Reducers

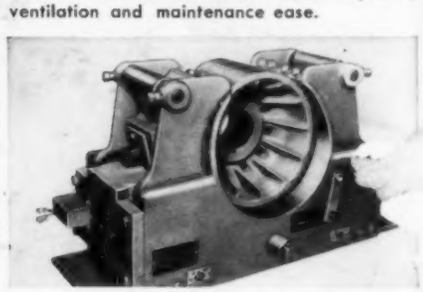


This 70-ton crane in a large steel mill—with a double hoist each rated 35 tons—is one of seven, all equipped with G-E crane drives, including Type MD-600 motors and hoist, bridge and trolley controls.

G-E crane control provides superior lowering performance for any hook load.



G-E MD-600 crane motors offer improved ventilation and maintenance ease.



G-E fast acting magnetic brake permits easy adjustment, requires less maintenance.

New control protects against overloads!

G-E hoist control panel solves tough motor maintenance problem; leads to choice of seven new G-E crane drives in large steel plant.

CO-ORDINATED

D-C CRANE DRIVES

Here's the kind of success story that's making General Electric crane control a heavy steel-mill favorite. In the box annealing building at this large mill, a 10-ton auxiliary hook on a mill crane was handling stacks of steel sheets to be put into annealing furnaces. Because the crane was frequently overloaded, two to four motor breakdowns a year had occurred over an eight-year period.

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Is *yours* a tough crane drive problem? General Electric—with over 40 years of experience in working with crane builders—can help you solve it. Ask your G-E steel-mill specialist about it; meanwhile send for Bulletin GEA-5408 on G-E d-c crane drives. *General Electric Company, Schenectady 5, N. Y.*

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